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Cost measurement in value-based healthcare – science or fiction? A systematic review.

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Title: Cost measurement in value-based health care – science or fiction? A systematic review.

Running head: Cost measurement in value-based health care

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ABSTRACT

Objective Value-based health care (VBHC) considers accurate cost information to be relevant to the pursuit of value, but little is known about how costs of care should be measured. The aim of this review is to identify how costs are measured in VBHC, and which cost measurement methods can facilitate VBHC or value-based decision making.

Design We systematically screen PubMed/MEDLINE, Embase, EBSCOhost and Web of Science with two reviewers following PRISMA guidelines, including studies up to 1/1/2022.

Eligibility criteria We require studies to measure costs of an intervention, treatment, or care path and to label the study as 'value-based'. An inductive qualitative approach was used to categorize studies following management accounting to identify if or how cost information facilitated VBHC by aiding decision making.

Results We find 1,930 studies, 215 of which measured costs in a VBHC setting. Half of all studies measure hospital costs (110, 51.2%) while the remainder use reimbursements. Sophisticated costing methods that allocate both direct and indirect costs to care paths can provide valuable managerial information by facilitating care path adjustments (40), benchmarking (39), the identification of cost drivers (47), and measurement of total costs or cost savings (26) We find three best practices important to success in costing: process mapping (34), expert input (16), and observations (24).

Conclusions Cost information can facilitate VBHC. While time-driven activity-based costing (TDABC) is prized as the best method, its ability to inform decision-making depends on its implementation. Costing short or partial care paths and surgical episodes produces accurate cost information but limited decision-making information. Practitioners are advised to prioritize costing full cycles of care and to consider both direct and indirect costs through TDABC.

Strengths and limitations

- Using two independent reviewers this systematic review analyzes and all value-based healthcare studies that have measured costs to date to provide a comprehensive comparison of cost measurement methods.
- By revealing four mechanisms through with cost measurement facilitates value-based healthcare, this research operationalizes the potential benefits of cost measurement to practitioners.
- By comparing the methods used by studies to collect cost information, this study finds three best practices for practitioners and researchers.
- Due to limiting the search to studies labeled as 'value-based' in the title or abstract, this review omits studies that measure costs in healthcare but do not explicitly pursue value-based healthcare.
- Included studies may have achieved value-based healthcare without reporting this in the paper, and therefore may be underrepresented in research question 2.

INTRODUCTION

To make value-based decisions in health care, hospital practitioners and health care providers require patient-level information on the costs and outcomes achieved in hospitals and health care organizations [1]. This enables care providers to steer towards better patient-reported outcome measures, patient-reported experience measures, and clinical outcomes at equal or lower cost [2]. With detailed cost and outcome information, care paths can be optimized continuously [3]. Value-based health care (VBHC) is therefore also considered one solution to the financial pressures our global health care system places on managers and administrators [1,4,5] based on its promise to streamline care by focusing on desirable outcomes. This is of relevance to hospital administrators and managers facing complex decisions under considerable financial pressures. Additionally, hospitals benefit from cost information by gaining insight into the sources of costs to guide cost-containment strategies. Cost information may therefore facilitate process and quality improvement initiatives pursued by management [6–10]. Furthermore, insight into patient-level or treatment-level costs enables hospitals to negotiate appropriate prices with insurance firms, especially as we move towards new payment models and away from fee-for-service payments [11,12]. Lastly, such treatment-level cost information is suggested to enable competition among hospitals based on outcomes and prices due to market forces [13].

Considerable research has addressed the outcome side of Porter's value equation and The Triple Aim [14]. Many studies measured patient-level outcomes from both the patient perspective (e.g., patient-reported outcome measures, patient-reported experience measures) and clinical outcome perspective [15,16]. Less is known about the cost side of this equation. Often, the term 'cost' is conflated with the price paid by insurance firms or patients to the hospital [17,18]. However, prices do not reflect the full costs incurred by hospitals [6,19–21]. Prices paid by

insurance firms are negotiated sums that include profit margins by both the insurer and the hospital [22]. They are also impacted by political factors, such as hospital-payor mix [23], which refers to the range of private vs. public insurance firms that make up the hospital's income stream. Lastly, fee-for-service payments fail to account for patient-level differences in care required. Reimbursements are therefore a poor indicator of costs.

Some authors argue for the implementation of time-driven activity-based costing (TDABC) as the 'golden standard' of cost measurement in healthcare organizations [3,5,15]. TDABC is a method of matching direct and indirect costs to activities in a fine-grained way, based on the amount of time an activity takes. A care path is made up of many activities, each generating costs. The costs of a care path can be calculated by first identifying all relevant costs to each activity, and then adding up those costs across the activities [22]. One step of this method called 'process mapping' presents care paths visually in a flowchart.

Though initial research is growing and promising, we have relatively little empirical evidence supporting TDABC as the best costing method to enable VBHC, as studies rarely compare methods of cost measurement or simply use whichever system the investigated hospital or care provider uses. Costing methods vastly differ by how they allocate indirect costs to products or services [24]; moreover, indirect costs cannot causally be attributed to patients and need to be properly allocated. One example of indirect costs are salaries of administrative personnel, e.g., front office staff who welcomes patients, coordinates schedules, or manages equipment such as a Da Vinci surgical robot system by Intuitive Surgical (Sunnyvale, CA, USA). While some methods ignore this (e.g., direct costing), other methods average indirect costs across days or months, or systematically allocate them to patients. These methods exist on a continuum from imprecise to fine-grained, with TDABC leaning towards fine-grained. This insight is particularly relevant to

health care, where indirect costs are high. The most fine-grained method is activity-based costing (ABC), which allocates indirect costs based on actual units of resources used per activity. In comparison, TDABC allocates indirect costs based on a per-minute cost, making it considerably easier to implement than ABC. Costing methods that do not consider the indirect costs of a care path underestimate the true costs of the care delivered.

Prior systematic reviews found that TDABC was able to facilitate VBHC, citing mostly cost savings as a result and without comparing it to alternative methods [3,4,15]. Therefore, we do not know how this compares to other cost measurement methods currently being used. While TDABC may be able to facilitate VBHC [5,15], it is unclear how these benefits compare to other costing methods currently used in practice. Therefore, the cost side of the value equation remains unclear. To address this challenge, we pose two questions:

RQ1: Which costing methods are currently being used by practitioners to facilitate VBHC?

RQ2: What are the consequences of applying one specific costing method in VBHC?

Such consequences may include whether the method enables cost reduction at equal or better outcomes or provides sufficient information to further improve a care path.

This comprehensive review draws on accounting literature [24] to categorize costing methods in empirical VBHC literature published over the last two decades (January 1, 2003 to January 1, 2022). Compiling the evidence in this way reveals four ways in which cost information facilitates VBHC and three best practices.

MATERIALS AND METHODS

Literature search strategy

To identify eligible studies, we systematically searched four major databases: Embase, Medline, Web of Science, and CINAHL EBSCOhost. Our search string (**online supplementary appendix)**

was developed by assessing previously identified relevant papers; it is designed to catch all studies that address VBHC and measure costs of an intervention, care path, or treatment by including the following specific terms:

> *cost*, microcost*, macrocost* AND [meaning in combination with] value-based, value based, OR valuebased

Prior search string testing showed that restricting the search to the phrase "value-based healthcare" excluded too many relevant studies because authors use "value-based perspective," "value-based equation," or similar variations when referring to VBHC. Conversely, the term "value" alone was too broad and yielded more than 40,000 mostly non-specific results. By using wildcard terms indicated by stars we include all variations on the term 'cost'.

Study eligibility criteria, record selection, and data collection

We limited inclusions to studies that were peer-reviewed empirical research and measured or estimated costs in a VBHC context. All inclusion criteria and variables extracted are detailed in the **online supplementary appendix**. The following variables were collected, inspired by Porter [2] and the cost measurement methods defined in accounting literature:

- Cost types included (direct vs. indirect).
- Cost perspective (provider, payer, patient).
- Portion of the care path costed (full, partial).
- Cost measurement method used (as labelled by the authors of the study).
- Cost measurement method applied, e.g. direct costing, absorption costing, step-down allocation, other recognized methods [24].
- Consequences of the costing information generated.

Patient and public involvement: This study did not involve patients or the public in designing, executing, or reporting of the research.

RESULTS

Record selection

Our four-person (ML, PP, HvE, KA) research group identified 3,275 relevant papers, of which 1,930 remained after deduplication. We conducted a trial screening of 30 papers to test and specify the screening criteria. The screening process comprised two rounds as shown in **Figure 1**. In Round 1, ML and PP screened the titles and abstracts independently. If there was uncertainty about the eligibility of the paper, it was included for the full-text screen following Bramer [25]. We admitted 674 studies based on titles and abstracts with a Cohen's kappa inter-rater reliability score of 0.78, indicating substantial agreement [26].

In Round 2, both ML and PP screened the full text of all 674 studies independently. 215 out of 674 studies were included for RQ1, with a Cohen's kappa of 0.76 between both ML and PP. HvE was included in the discussion as needed. Lastly, we assessed whether the paper discussed if or how the costing information facilitated VBHC (RQ2), yielding 49 cases in which the costing method facilitated VBHC. This review was not registered.

Figure 1 here

Figure 1. PRISMA flowchart depicting screening, exclusion, and inclusion process with 2 reviewers.

Descriptive characteristics

An overview of the included studies is provided in **Table 1**. Our earliest study is from 2005, with a spike in studies for 2017. Just under half (n=98, 45.6%) of studies were published in the last two years. An overwhelming majority is from the US (n= 178, 82.8%). Europe is the second most common continent with 22 (10.6%) studies being European, 9 (4.2%) of which are Dutch.

The three largest medical specialty groups represented are surgical (n=99; 46.0%), oncology (n=37; 17.2%) and paediatrics (n=19; 8.8%). The complete list of 215 inclusions is summarized in the **online supplementary appendix**. Extracted data is available in the **supplementary file**.

Characteristic	n	%
Year published		
2005-2009	3	1.4%
2010-2013	6	2.8%
2014	6	2.8%
2015	7	3.3%
2016	9	4.2%
2017	17	7.9%
2018	28	13.0%
2019	41	19.1%
2020	43	20.0%
2021	51	23.7%
2022 as per 1/1/2022	4	1.9%
Geography		
Americas		84.3%
Brazil	3	
Canada	1	
US *of which*	178	
Boston, 8		
California, 18		
New York, 23		
Texas, 12		
Pennsylvania, 9		
Other states, 108		
Asia		2.3%
China	1	
Iran	1	
Kuwait	1	
Lebanon	1	
Singapore	1	
Europe		10.6%
Andalusia	1	
Germany	1	
Italy	3	
Norway	1	
Serbia	1	
Spain	2	
Netherlands	9	
UK	4	
Oceania		1.9%
Australia	4	
Transcontinental		0.9%
Russia	1	
Turkey	1	

Characteristic	n	%
Topic		
Cardiology	5	2.3%
Dermatology	1	0.5%
Emergency & acute care	11	5.1%
Endocrinology	3	1.4%
Surgical, *of which*	99	46.0%
Appendicitis, 2		
Abdominal, 6		
Bariatric, 2		
Cardiac/Thoracic, 12		
Colon/Rectal, 2		
Endocrine, 2		
Ear/Nose/Throat, 2		
Gallbladder, 2		
Liver, 2		
Neurosurgical, 5		
Orthopaedic arthroplasty, 25		
Orthopaedic fracture, 12		
Orthopaedic rotator cuff repair, 2		
Orthopaedic other, 3		
Plastic surgery, 2		
Spine, 13		
other surgical, 5		
Geriatrics	1	0.5%
Gynaecology & obstetrics	8	3.7%
Infectious disease	1	0.5%
Internal medicine	12	5.6%
Multiple	3	1.4%
Nephrology	1	0.5%
Neurology	2	0.9%
Oncology	37	17.2%
Ophthalmology	3	1.4%
Orthopaedic	1	0.5%
Pain medicine	3	1.4%
Paediatrics *of which*	19	8.8%
Appendicitis, 3		
Emergency & acute care, 2		
Neonatal, 3		
Oncology, 1		
Surgical, 5		
Surgical, plastic surgery, 2		
Other paediatric, 3		
Toxicology	1	0.5%
Urology	4	1.9%

Table 1. Characteristics of value-based health care studies measuring costs (n=215).

Which cost measurement methods are currently being used to facilitate VBHC?

To answer RQ1, we look at how costs were measured. A summary of our findings is presented in **Table 2**. The literature contains many overlapping and contradicting terms, as costs can refer to insurer costs, reimbursements, hospital costs, or patient costs. About half (n=110, 51.2%) take the provider perspective, meaning costs were calculated for the hospital or care facility. Many studies use charges or payments because hospital cost data are unavailable, considering charges to be a relative proxy. Some studies use terms such as 'costs,' 'charges,' 'prices,' 'payments,' and 'reimbursements' interchangeably, making it difficult to differentiate [17,18,27–30]. For example, Jain et al, [17] stated, "The terms reimbursement, cost, and payment have been used interchangeably throughout the text to represent actual amounts paid by insurers." Similarly, Robles et al, [30] explained, "Total hospital charges were utilized in this standardized costing analysis. Hospital charge data provides a relative measure of the 'cost' of episodes of care, as actual cost data are generally not ascertainable in the healthcare setting." When calculating costs with TDABC, Ahluwalia et al, [31] called these costs 'prices.' To address this confusion, some recent studies refer to provider costs as the 'true cost' of care [6,7,9,19]. A portion of studies comparing several cost types [19,20] also differentiate 'traditional hospital accounting' costs vs. 'true costs' calculated with TDABC [6,9,20,32,33].

Characteristic	Studies n	Studies %	Perspectives n	Perspectives %		
Cost perspective						
Provider	110	51.2%	111	51.6%		
Insurer	103	47.9%	106	49.3%		
Patient	2	0.9%	5	2.3%		
N*	215		222			
	All studies (n=215)				Provider only	Payer only
Cost types included						
Direct	28		13.0%		24	2
Direct and indirect	177		81.9%		84	93
Unspecified	10		4.6%		2	8
Costs measurement implementation						
No, costs measured for purpose of study	34		15.7%		33	
Yes, costing method is implemented	39		17.6%		39	
Unspecified or not applicable	142		66.2%		38	102
Costs coverage						
Full care path	47		21.8%		30	16
Full care path (full surgical episode)	17		7.4%		13	4
Partial care path (full surgical episode)	22		8.3%		19	3
Partial care path	86		42.1%		37	49
Unspecified	43		19.9%		11	31

Note: N differs between studies and perspectives because seven studies measured two cost types.

Table 2. Characteristics of costing methods in value-based health care

We categorized studies based on the cost types they include. Both direct and indirect costs were considered by 177 (81.9%) studies, while 28 (13.0%) papers only included direct costs.

Next, we looked at whether costs were calculated for a complete care path. We found 64 (29.8%) studies measure costs for a full care path, of which 16 (7.4%) are full surgical episodes but labelled so without considering all pre- or post-surgical costs. The remaining 86 (42.1%) measures costs for a partial care path.

Table 3 categorizes studies based on their costing method used. For those papers measuring costs within the care provider, we found two clear categories in line with management

accounting literature[24]. The first is direct costing (n=23), where direct costs of care are summed up and indirect costs are not considered. This implies that if costs cannot causally be attributed to the treatment of a specific patient, they are not considered and hence neglected when making managerial decisions [24].

Studies considering direct and indirect costs use absorption costing, whereby indirect costs are allocated to patients [31]. These include but are not limited to TDABC (n=31) and ABC (n=7), in which costs are allocated per individual care activity (e.g., a consultation or treatment step). The remaining absorption costing papers (n=47) also consider direct and indirect costs, but how indirect costs are attributed to activities are not reported. Authors of absorption costing studies state that cost information was calculated based on diagnosis-related group costs, micro costing, bottom-up clinical costing, or hospital accounting system not further classified. A full list of all terms used is presented in the **online supplementary appendix.**

Perspective	Method	n
Provider	Direct costs only	
	Direct costing	23
	Absorption costing	
	ABC	7
	TDABC	31
	Other	47
	Not specified	3
Insurer	Charges & reimbursements	
	Charges, reimbursements, claims	81
	Charges adjusted with cost-to-charge ratio	25
Patient	Out-of-pocket costs to patient	5

Note: Total number of studies here is 222; seven studies measure two cost types. Studies are classified based on actual costs included and methods described, not necessarily the labels used by authors.

Table 3. Overview of cost measurement methods used in value-based health care

How do these costing methods facilitate VBHC?

To answer RQ2, we extracted all consequences described by papers related to the costing method. Not all studies included to address RQ1 describe facilitating VBHC, or the consequences of the cost information generated. Here, we were looking for how the costing information facilitated VBHC, similar to Etges et al, [3]. These reported consequences were grouped inductively, revealing four categories:

1. Identification of cost drivers, in terms of cost items (e.g., staff costs, material costs) or activities (e.g., surgery, initial consult; n=48).
2. Comparison of costs across patients' groups, care providers, or procedures (n=39).
3. Measured cost difference, or cost saving, at equal or better care (n=26).
4. Suggested or measured care path improvements (n=40).

These studies are presented in **Table 4**. The studies reporting these facilitators used ABC (n=6), TDABC (n=29), other absorption costing methods (n=12), or direct costing (n=3).

Study Characteristics						Best practices				Value-Based consequences of costing information			
	Medical Specialty	Costing method	period	Centre	Study type	PM	EI	DO	CG	Compare costs across	ICD	MPS	Care path adjustment
[34]	Internal medicine	TDABC	partial	single	retro	yes	yes		items, activities		yes		suggested
[33]	Surgical, orthopaedic, rotator cuff repair	TDABC	full (FSE)	single	retro	yes		yes	items, activities	surgeons, two alternative treatments	yes	yes, ± $727 about the mean per patient	suggested
[4]	Cardiology, surgical	TDABC	full (FSE)	multi	retro	yes	yes	yes	items, activities	hospitals, procedures	yes	yes, estimate 51.0% of procedure cost	yes
[10]	Oncology	TDABC	full	single	retro	yes	yes	yes	items, activities	treatment care paths	yes	$2,302 (25.0%) difference across treatments	suggested
[35]	Surgical, orthopaedic	TDABC	full (FSE)	single	retro	yes			items, activities	patients	yes		suggested
[36]	Surgical, orthopaedic	TDABC	full (FSE)	single	retro	yes			items, activities	patients	yes		suggested
[19]	Surgical, orthopaedic	TDABC	full (FSE)	single	retro	yes		yes	items, activities	costing methods (TA and TDABC)	yes		suggested
[20]	Surgical, orthopaedic	TDABC	full (FSE)	single	retro	yes		yes	items, activities	five treatments, cost vs. reimbursement	yes		
[37]	Paediatric, surgical, plastic surgery	TDABC	full (FSE)	multi	pro	yes		yes	items, activities	treatment care paths	yes	up to $8900, but long-term outcomes yet unknown	suggested
[38]	Emergency & acute care	TDABC	full (multiple)	multi	retro	yes	yes	yes	items, activities	eight care paths for acute ureteral stones (patient journeys)	yes	yes, $6614 difference across care paths	suggested
[39]	Surgical, orthopaedic	TDABC	full (FSE)	single	retro	yes		yes	items, activities	surgeons	yes		suggested
[40]	Oncology	TDABC	partial	single	pro	yes	yes	yes	items, activities	treatments and individual care paths	yes	yes, cost difference of up to 3.33 times, depending on case mix	suggested
[41]	Oncology (incl. surgery)	TDABC	full	single	retro	yes		yes	items, activities		yes		suggested
[42]	Oncology	TDABC	partial (FSE)	single	retro	yes			items	pre and post implementation	yes	yes, mean cost savings of €309 per patient	yes
[43]	Cardiology	AC (other)	partial	multi	retro				items	patient journeys	yes		suggested
[44]	Emergency & acute care	AC (other)	partial	single	retro	yes			items	surgeons	yes		
[45]	Surgical, bariatric	AC (other)	full (FSE)	single	retro				items	treatment	yes		
[46]	Gynaecology & obstetrics	AC (other)	full	single	retro	yes			items, activities	procedures	yes	yes, $967 per patient	suggested
[47]	Emergency & acute care	AC (other)	partial	single	retro				items, activities		yes		
[48]	Surgical, colorectal	AC (other)	partial (FSE)	single	retro				items	intervention	yes	yes, reduced variable cost, similar total cost	yes
[21]	Surgical, orthopaedics, fracture	ABC	partial (FSE)	single	retro				items	patients, patient groups, demographics	yes		
[49]	Surgical, orthopaedic, arthroplasty	ABC	full (FSE)	single	both		yes	yes	items, activities	treatment care paths	yes	estimate €2,054,000 annually	yes
[50]	Surgical, spine	ABC	Full	single	retro	yes			items, activities	patients, patient groups	yes		suggested
[6]	Paediatric, surgical	TDABC	full (FSE)	single	both	yes		yes	items, activities	costing methods (TA and TDABC)	yes	20.0% and without care path alteration	suggested
[51]	Oncology	TDABC	full (FSE)	single	retro	yes	yes	yes	items, activities	treatment care paths	yes	yes, estimate for each 10.0% decrease in case duration, total costs could decrease by about 8.0%.	suggested
[31]	Surgical, orthopaedic	TDABC	full (FSE)	single	pro	yes	yes	yes	items, activities	treatment care paths	yes	£2,018 per patient	suggested
[52]	Paediatric, neonatal	TDABC	partial	single	retro	yes	yes	yes	items, activities	Pre and post intervention	yes	yes, 36.0% or $92,000 per tracheostomy care cycle	yes
[53]	Surgical, cardiac/thoracic	AC (other)	partial	multi	retro	yes			items	patients, implant devices	yes		suggested

[54]	Oncology, surgical	AC (other)	partial	single	retro				items		yes	yes, multiple	
[55]	Multiple	TDABC	full	multi, pilot	retro	yes	yes	yes	items, activities	before and after intervention (IPUs)	yes	yes, quarterly costs declined	suggested
[56]	Oncology	TDABC	partial (PSE)	single	pro	yes		yes	items, activities	treatment care paths (parallel vs. induction design in OR)	yes	yes, estimate OR time reduction of 55 min, or $,2818 missed revenue	suggested
[57]	Surgical, orthopaedics fracture	TDABC	partial (FSE)	single	both	yes			items		yes		suggested
[58]	Surgical, foot debridement	TDABC	partial (FSE)	single	retro			yes	items	before and after intervention	yes		yes
[59]	Ophthalmology	TDABC	full	single	retro	yes	yes	yes	items, activities		yes		suggested
[60]	Gynaecology & obstetrics, surgical	AC (other)	partial (FSE)	single	retro				items		yes		suggested
[61]	Gynaecology & obstetrics, surgical	AC (other)	partial (FSE)	single	retro				items		yes		
[62]	Multiple	Direct costing	partial	single	retro				items		yes		
[63]	Surgical, orthopaedic	Direct costing	full (FSE)	multi	retro				items	intervention		yes, £255 per patient	yes
[5]	Surgical, carpal tunnel release	TDABC	partial (FSE)	multi	retro	yes		yes	items, activities	multiple treatment care paths	yes	yes, 70.9% ($27,103) and 31.6% ($178)	yes
[64]	Surgical, appendicitis	AC (other)	partial (FSE)	single	pro		yes	yes	items	pre and post intervention (dashboard)	yes	yes, decreased by $496 per operation	yes
[65]	Surgical, orthopaedic	Direct costing	partial (FSE)	single	retro		yes		items	intervention	yes		
[8]	Urology	TDABC	partial	single	pro	yes		yes	items, activities		yes	yes, estimate two hours per cycle	suggested
[66]	Paediatrics, appendicitis	TDABC	full (FSE)	single	pro	yes	yes	yes	items, activities	treatment care paths (pre and post intervention)	yes	11.0% cost reduction, and 51.0% hospitalization time reduction	yes, several
[67]	Urology	AC (other)	partial	multi	retro		yes		items				
[7]	Oncology, surgical, 11 surgeries	TDABC	Partial (FSEs)	single	retro	yes			items, activities	potential staffing ratios	yes	estimate 13.0-28.0% per surgery type	modelled and suggested
[9]	Oncology	TDABC	full	single	retro	yes	yes	yes	items, activities	treatments (high-dose vs. low-dose brachytherapy)	yes	$2,668 difference across treatments	yes
[68]	Urology	TDABC	partial (FSE)	single	retro	yes	yes		items, activities	five treatment care paths	yes	yes, 400.0% increase from least to most expensive pathways	suggested
[32]	Surgical, neurosurgery	ABC	partial (FSE)	single	retro	yes			items, activities	patients	yes	yes, 25.0%	yes, several
[69]	Surgical, neurosurgery	ABC	partial (FSE)	single	retro	yes			items, activities	patients	yes		suggested
[70]	Paediatric plastic surgery	ABC	partial, 1 year	single	retro				items	patients	yes		suggested
					Count	***34***	***16***	***24***		***39***	***47***	***26***	***40***

Note: ABC: Activity-Based costing; TDABC: Time-Driven activity-based costing; FSE: Full surgical episode; AC (other): Absorption costing, other; PSE: Partial surgical episode; Retro: Retrospective; Pro: Prospective; PM: Process mapping; EI: Expert input; DO: Direct Observation; CG: Cost grouping, cost items only or activities; ICD: Identify cost drivers; MPS: Measured provider cost savings (at equal or better care). Costing methods are classified based on actual reported costs and methods applied, not necessarily the labels used by authors.

Table 4. Costing method applications, method used, and consequences, sorted by year.

Activity-based costing

All six studies applying ABC explained that they did so because this was the provider's existing costing method. Three of these studies measured costs for a full surgical episode [21,32,69] as part of a longer care path, two measured costs for a full care path [49,50], and one measured costs of a partial care path [70]. While these studies all applied ABC, their ability to facilitate VBHC differs. Jacobs et al [50] measured costs for a complete care path for patients with adult spinal deformity, a complex care path spanning about one year. The authors compared costs across patient groups and patients, found major cost drivers, and suggested where to concentrate cost containment. Similarly, McLaughlin et al [32,69] both measured costs, identified cost drivers and evaluated targeted cost containment initiatives. In their paper [32], the cost containment initiatives were informed by the costing information—activities with the highest costs were targeted for reduction—and a 25.0% total cost reduction was achieved. While McLaughlin et al [69] identified comorbidities and demographics strongly related to the total costs in patients undergoing neurosurgery, Wise et al [21] found the opposite for geriatric hip fracture patients. This study identified cost drivers, and costs were compared across patient groups. McLaughlin et al [71] were able to measure and record costs savings of 25.0%, and Vanni et al [49] successfully predicted about €2,054,000 annual cost savings associated with an alternative enhanced recovery pathway.

Time-driven activity-based costing

The largest portion of papers included for RQ2 used TDABC. These studies were able to identify significant cost drivers linked to activities in a care path, and some suggest where to target improvement initiatives [4,6–8,10,33,40,59]. A large selection of TDABC studies was able to suggest (n=19) [6,8,10,19,33–38,40,41,51,55–59,68] or measure (n=6) [5,9,31,42,52,66] care path improvements as shown in **table 4**.

The length and specificity of the care paths costs varies greatly. Some studies were narrow in scope and breadth, calculating costs for sub-sections of a single care path or surgical procedure [6,8,38,39,56]. Isaacson et al [8] calculated costs for cleaning a single reusable piece of equipment, while others costed single surgical days [6], compared alternative surgeons [39] or anaesthesia solutions within a care path [56]. In this group, McClintock et al [38] took the broadest perspective by mapping individual patient journeys.

The largest group of TDABC studies measured costs across care paths, within a single provider, and for a single diagnosis (n=10) [9,10,31,33,37,40–42,51,66]. Typically, these studies compared costs between a new intervention and usual care [9,10,31,51,52,66], or alternative care paths [33,37,40,42] in order to measure cost savings.

Some studies were broader in scope, costing multiple care paths or treatments within one specialty [5,7,20,68], an entire department [34,59], or multiple practice units [55] or providers [4]. Some compared 'true costs' calculated with TDABC across care providers within specialties or care paths [4,37], while others argued TDABC costs are too subjective to be compared across hospitals [10,38]. While most identified studies compared costs across care paths, some also compared costs across patient groups [19,35,36] or even individual patient journeys [38,40].

Technology played a large role in studies aiming to reduce costs. One study was able to suggest how to use technology more efficiently [6], and some show how technology can reduce costs [37,40,51] by integrating technological investments in the TDABC cost calculated. Conversely, studies using unspecified absorption methods did not include investments in technology such as a Da Vinci robot mentioned above [60,61]. This is surprising because absorption costing methods require indirect costs to be allocated.

Analyses enabled by activity-based and time-driven activity-based costing

Several ABC and TDABC studies compared costs calculated with traditional accounting costs [6,19,20] or reimbursements [20,21], finding that prices do not equal costs. Some conducted quantitative analyses using the cost information generated with ABC or TDABC. These include regression analyses to identify correlations [7,33,35,36,40], compare patient groups [20,35,36], and compare costs and outcomes across a matched patient sample [40].

Two recent studies conducted patient-level value-analysis (PLVA)[33,40], comparing patient-reported outcomes with patient-level TDABC costs. Wise et al [33] did so for rotator cuff repair surgeries over the span of one year, while McCreary et al [57] analyzed ankle fractures. Both studies found costs to be unrelated to patient-reported outcome measures.

Other absorption costing methods and direct costing

Other absorption costing methods used by studies were labelled as micro costing (n=5), bottom-up clinical costing [47], or were described but not labelled (n=6). Most were able to find cost drivers (n=12, for details see **table 4**) and some could compare costs within providers. Notably, Robinson et al,[64] used the cost information to build and evaluate a dashboard that provides real-time feedback to surgeons during operations and monthly, decreasing costs significantly. Some studies omitted cost categories, e.g., equipment [61]. Direct costing enabled cost driver identification [62,63,65], and in some instances granular cost measurement.

Best practices

After finding these four facilitators, we compared studies to find common practices. This is of particular importance because costing methods are not labelled consistently. For example, many studies refer to ABC as 'bottom-up costing.' To look beyond labels, we compared the exact methods used to measure costs. We found that studies able to facilitate VBHC used process

mapping (n=34), expert input (n=17), and/or direct observations (n=24) when measuring costs. These practices overlap with TDABC best practices but are not exclusive to TDABC, as shown in **Table 4**.

Studies that made specific care path improvement suggestions used process mapping, and especially those with a multidisciplinary team reported great benefits [4,9,10,19]. This enables experts (doctors, care professionals, administrators) with the required knowledge and experience to reflect critically on the process [4,9,10,19] which resulted in actionable suggestions. In comparison, studies that did not use process mapping could suggest minimizing high-cost items (e.g., total operating time, nursing costs) but could not couple these suggestions to activities, or chronological points in the care path. Only commenting on cost items, instead of chronological time points, limits the ability of cost information to inform management on where to focus process improvement initiatives.

Expert input while creating process maps or measuring costs was often cited by authors as being valuable, especially for estimating preparation time or other behind-the-scenes activities that do not involve the patient but are critical to delivering care. Some studies unable to use expert input cited this as a limitation of their work. Rare cases also evaluated the impact of costing information, for example by involving experts in evaluating a dashboard [64].

Lastly, direct observations were used by some studies, particularly those calculating process times down to the minute or those measuring costs for individual patient journeys.

DISCUSSION

This review focused on VBHC studies measuring or estimating costs, and on identifying which costing methods can facilitate VBHC. By assessing the consequences of the costing methods used, we were able to identify the characteristics of costing methods that facilitate VBHC.

Previous research found that TDABC can facilitate VBHC through cost containment and process improvements [3,15]. We build on these by comparing value-based consequences across costing methods. While the field is young and alternatives seem scarce, we have found considerable evidence that TDABC and ABC can indeed facilitate VBHC. As previously mentioned, TDABC is considerably easier to implement than ABC, which leads us to recommend it over ABC. We found no well-documented alternatives to TDABC or ABC in our review. Not all TDABC studies were able to achieve the facilitating factors we describe here. We emphasize the need for future studies to follow TDABC guidelines properly and to document the methods used explicitly. Several included studies in this review simply stated that TDABC was applied, outsourced, used with incomplete costs, or used without listing exact cost rates.

Care path start and endpoints are well-documented by authors, but remain inconsistent. To view costs in relation to outcomes as suggested by Porter [2], total costs from start to finish of a trajectory must be considered [72]. Many studies chose the start and endpoints to their cost measurement windows ad hoc and labelled this a full care path. Consequently, this results in inconsistencies across studies, limiting comparisons. A selection of more recent studies measured costs for a true full care path from beginning to end. Future research should do the same, and explicitly define start and endpoints. This would allow for consistent comparison across providers. Like ICHOM standard outcome sets produced by the International Consortium for Health Outcomes Measurement, costs could be catalogued and compared for full care paths. In a recent expert consensus study, experts reached consensus on the need for focusing on full care paths [72].

Furthermore, we see a trade-off in the specificity and length of the care path costed. Studies measuring costs for parts of a care path (e.g., a surgery) can provide detailed costs for that portion of the care path, but not total costs of care per patient because the remainder of that patient's care path is not included. Some surgical studies measured costs for partial care paths, and often concluded that operating theatre time should be minimized due to high surgeon and operating theatre costs.

This is a conclusion with limited impact for the value agenda [13] because it does not provide cost information for an entire care path, or advice for how to circumvent the surgery. Yet, studies measuring costs for complete care paths presented less detailed costing methods (due to the sheer length of the care path) but were able to compute total costs of care per patient. This enabled cost benchmarking across providers, as well as cost comparisons of new vs. standard care, or treatment alternatives. This allowed providers to steer towards outcomes at lowest costs to maximize value. Future research should focus on measuring costs for full care paths, and on comparing costs to outcomes as demonstrated by some of the more recently published studies included in our review [33,40,57].

Our review highlights the need to involve medical professionals in this process, both when implementing costing methods as well as when evaluating the results. Future cost measurement studies, and hospitals looking to implement TDABC, should do so with multidisciplinary teams. Studies that have involved medical professionals in the process of cost measurement and usage were able to improve care paths via improvement initiatives and/or dashboards. This suggests that generating and using costing information can be viewed as a process. Future qualitative research should follow this process to better understand the mechanisms through which this happens, and

the impact of staff involvement on cost containment success. Previous research suggests that staff involvement is critical as it builds trust in the model [73].

Limitations and future research

We acknowledge several limitations related to the scope, breadth, and quality of the included studies. Firstly, our search strategy does not capture studies that measure costs but do not label the study as VBHC-oriented. Not all TDABC studies make value-based claims or contributions and may therefore be underrepresented in our review. Additionally, not all studies explicitly discuss the impact or consequence of the costing method applied, which may impact our findings. Future qualitative research should implement TDABC and evaluate whether the facilitating factors found in this review are achieved. Secondly, sophisticated methods such as TDABC are currently used in predictable and/or short care paths such as orthopaedic surgeries. Further research testing the feasibility and practicality of TDABC in different settings, such as emergency on-call care, or long care paths such as fertility treatments, is warranted. Our findings may have limited generalizability across medical specialties as indicated in **Table 1**. Finally, we rely on the reporting of authors which differs in style and quality across disciplines and journals. We partially circumvented this limitation by looking beyond the cost measurement labels used by authors, and extracting the costs included and methods used. However, we cannot exclude the potential for error, or lack of explicit reporting, in the studies reviewed.

Conclusion

This systematic review reveals that cost information at the treatment or patient level, for complete care paths, enables value-based decision making through several mechanisms. Such cost information directs quality and process improvement initiatives, next to informing reimbursement

amounts. Practitioners and academics should apply process mapping, expert input and observations when implementing absorption costing systems such as ABC or TDABC. Hospital cost measurement is strongly advised.

Patient and public involvement: This study did not involve patients or the public in designing, executing, or reporting of the research.

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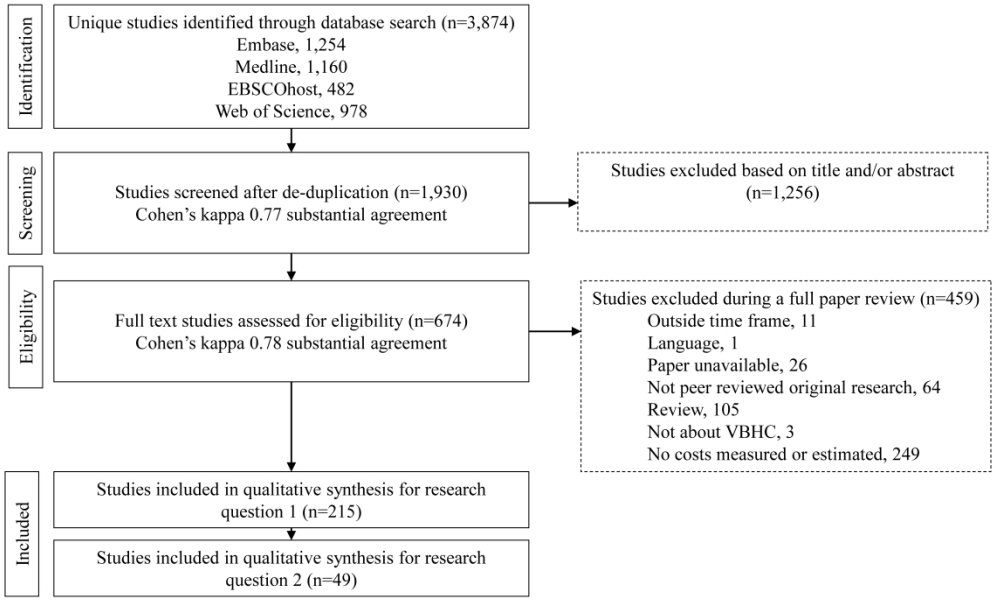

PRISMA flowchart depicting screening, exclusion, and inclusion process with 2 reviewers.

1428x873mm (96 x 96 DPI)

Inclusions RQ1 (215) extracted data to be shared with Erasmus Data Repository (FigShare)

Authors	Year Pub	Title paper (see full reference in manuscript)	Geography (country) of study	Geography, state of country, if N/A country	study design (if incl. in RQ2)	unit of analysis	disease/topic labels provided by study (overlapping tags, can be multiple)	Medical Specialty (non overlapping labels)	Medical Specialty sub category, where applicable	Care path studied	Costs included	Costs perspective (all)	Primary Cost perspective	Secondary Cost perspective if applicable	Costing method used as described in study	Primary Costing method classification	Secondary Costing method classification, if applicable	Implementation of costing method (N/A if reimbursements or charges, unspecified if not discussed in study)	if reimbursement; actual measurement used for estimation	RQ2 included - discuss consequences or impact of cost information in study
Gálvez, A. C. M. Sánchez, F. J. Moreno, C. A. Pérez Fernández, A. J. García, R. B. López, M. C. Ramírez, M. P. P.	2020	Value-based healthcare in ostomies	Andalusia	Andalusia		71 surgical ostopmy patients	digestive, urology, surgical	Urology		partial care path (full surgical episode)	Direct and indirect	provider	provider		unspecified	Absorption costing - unspecified/generic		Paper only		no
McLaughlin, N. Upadhyaya, P. Buxey, F. Martin, N. A.	2014	Value-based neurosurgery: Measuring and reducing the cost of microvascular decompression surgery	US	US; California	single center, retrospective	44 neurosurgical patients	neurosurgical, microvascular decompression, trigeminal neuralgia (TN) or hemifacial spasm (HFS)	Surgical	Neurosurgery	partial care path (full surgical episode)	Direct and indirect	provider	provider		ABC	Absorption costing - ABC		implemented		yes see second sheet
Hennink, S. D. Hofland, N. Gopie, J. P. Van Der Kaa, C. De Koning, K. Nielsen, M. Tops, C.	2016	Value-based healthcare in Lynch syndrome	The Netherlands	The Netherlands		64 Lynch Syndrome patients	oncology, lynch syndrome, colorectal cancer	Oncology		full care path	Direct and indirect	provider	provider		unspecified	Absorption costing - unspecified/generic		unspecified		no
French, K. E. Guzman, A. B. Rubio, A. C. Frenzel, J. C. Feeley, T. W.	2016	Value based care and bundled payments: Anesthesia care costs for outpatient oncology surgery using time-driven activity-based costing	US	US; Virginia	single center, retrospective, multiple care paths	5,357 outpatient anesthesia cases across 11 procedure groups	oncology	Oncology		partial care path (full surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		implemented		yes see second sheet
Tan, R. Y. C. Met-Domestici, M. Zhou, K. Guzman, A. B. Lim, S. T. Soo, K. C. Feeley, T. W.	2016	Using quality improvement methods and time-driven activity-based costing to improve value-based cancer care delivery at a Cancer Genetics clinic	Singapore	Singapore	single center, retrospective, process mapping, observation	251 Patients with high-risk features suggestive ofhereditarycancer	oncology, genetics, Cancer genetics	Oncology		partial care path	Direct	provider	provider		TDABC	Direct costing		unspecified		no
Danilyants, N. MacKoul, P. Baxi, R. van der Does, L. Q. Haworth, L. R.	2019	Value-based assessment of hysterectomy approaches	US	US; Maryland	single center, retrospective	2689 patients, female, 18 or over	gynecology, vaginal hysterectomy, robot, robot-assisted	gynecology & obstetrics		partial care path (full surgical episode)	Direct and indirect	provider	provider		Microcosting supplemented with charges	Absorption costing - unspecified/generic		Paper only		yes see second sheet
Hernandez, A. Kaplan, R. S. Witkowski, M. L. Forrest Faison, C. Porter, M. E.	2019	Navy medicine introduces value-based health care	US	US; Florida	single center, retrospective, multiple care paths, pilot project	22877 patients total	pregnancy, osteoarthritis, diabetes, lower back pain, multiple	gynecology & obstetrics		full care path	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		implemented		yes see second sheet
Parra, E. Arenas, M. D. Alonso, M. Martínez, M. F. Gamen, Á Aguarón, J. Escobar, M. T.	2017	Assessing value-based health care delivery for haemodialysis	Spain	Spain	multi center, retrospective	5 haemodialysis treatment centers, patients unspecified	haemodialysis, renal	Urology		partial care path	Direct and indirect	provider	provider		Microcosting	Absorption costing - unspecified/generic		Paper only		yes see second sheet
Brown, G. C. Brown, M. M. Brown, H. C. Kindermann, S. Sharma, S.	2007	A Value-Based Medicine Comparison of Interventions for Subfoveal Neovascular Macular Degeneration	US	US; Pennsylvania		233 patients with age-related macular degeneration	Ophthalmology, Neovascular, macular degeneration	opthalmology		partial care path	Direct	payer	payer		none, reimbursements	Charges/Reimbursement-based		N/A	average medicare reimbursements	no
Medbery, R. L. Chadid, T. S. Sweeney, J. F. Knechtle, S. J. Kooby, D. A. Maithel, S. K. Lin, E.	2014	Laparoscopic vs open right hepatectomy: A value-based analysis	US	US; Georgia		105 patients total, elective laparoscopic liver resection surgery or open right hepatectomy	Surgical, Hepatectomy, Laparoscopic liver resections	Surgical	Liver	partial care path	Direct and indirect	provider	provider		unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic		implemented		no
Danilyants, N. MacKoul, P. van der Does, L. Haworth, L. Baxi, R.	2019	A value-based evaluation of minimally invasive hysterectomy approaches	US	US; Maryland	single center, retrospective	2689 patients, female, 18 or over	gynecology, vaginal hysterectomy, robot, robot-assisted	gynecology & obstetrics		partial care path (full surgical episode)	Direct and indirect	provider	provider		Microcosting	Absorption costing - unspecified/generic		Paper only		yes see second sheet
Gabriel, L. Casey, J. Gee, M. Palmer, C. Sinha, J. Moxham, J. Calvert-Stone, T. L.	2019	Value-based healthcare analysis of joint replacement surgery for patients with primary hip osteoarthritis	UK	UK; London		50 patients primary hip osteoarthritis	orthopedics, joint replacement, total hip replacement, Hip osteoarthritis	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	provider	provider		Patient Level Information Costing System methodology (PLICS)	Absorption costing - unspecified/generic		implemented		no
Van Deen, W. K. Spiro, A. Burak Ozbay, A. Skup, M. Centeno, A. Duran, N. E. Leary, B. N.	2017	The impact of value-based healthcare for inflammatory bowel diseases on healthcare utilization: A pilot study	US	US; California		60 patients with inflamatory bowel disease	IBS, bowel, Inflamatory bowel disease	Internal Medicine		full care path	Direct and indirect	payer	payer		none, reimbursements	Charges/Reimbursement-based		N/A	Medicare reimbursements based on DRG/HCPS codes	no

Isaacson, D. Ahmad, T. Metzler, I. Tzou, D. T. Taguchi, K. Usawachintachit, M. Zetumer, S.	2017	Defining the Costs of Reusable Flexible Ureteroscope Reprocessing Using Time-Driven Activity-Based Costing	US	US; California	single center, direct observation, process mapping	10 Uteroscopes	Urology, Ureteroreneoscopy	Urology		partial care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Ionov, M. V. Zhukova, O. V. Yudina, Y. S. Avdonina, N. G. Emelyanov, I. V. Kurapeev, D. I. Zvartau, N. E.	2020	Value-based approach to blood pressure telemonitoring and remote counseling in hypertensive patients	Russia	Russia		240 hypertensive patients	Blood pressure, hyperternsion, Blood pressure telemonitoring and remote counselling (BPTM)	Cardiology		partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		no
Annabathula, R. Dugan, A. Bhalla, V. Davis, G. A. Smyth, S. S. Gupta, V. A.	2020	Value-based assessment of implementing a Pulmonary Embolism Response Team (PERT)	US	US; Kentucky		634 patients, 18 or over, acute Pulmonary Embolism	Cardiology, pulmonary embolism	Cardiology		unspecified	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	total reimbursements	no
Goretti, G. Marinari, G. M. Vanni, E. Ferrari, C.	2020	Value-Based Healthcare and Enhanced Recovery After Surgery Implementation in a High-Volume Bariatric Center in Italy	Italy	Italy		2122 patients, morbidly obese, bariatric surgery	Obesity, surgical, bariatric surgery, Morbid Obesity	Surgical	Bariatric	unspecified	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	Paper only		no
Konda, S. R. Lott, A. Egol, K. A.	2020	Development of a Value-based Algorithm for Inpatient Triage of Elderly Hip Fracture Patients	US	US; New York		361 operative hip fracture patients	Geriatrics, trauma, hip fracture	Surgical	Orthopedic fracture	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Ennis, R. D. Parikh, A. B. Sanderson, M. Liu, M. Isola, L.	2019	Interpreting oncology care model data to drive value-based care: A prostate cancer analysis	US	US; New York		210 patients, 377 episodes of care	Oncology, Hematology, prostate cancer	Oncology		full care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Denneny, J. C. Cyr, D. D. Witsell, D. L. Brereton, J. Schulz, K.	2019	A pathway to value-based care of chronic rhinosinusitis using a claims database	US	US; Maryland		7499183 patients, 18-64, acute rhinosinutitis	Rhinosinusitis, Typical chronic rhinosinusitis	Surgical	ENT	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	claims	no
Peele, P. Keyser, D. Lovelace, J. Moss, D.	2018	Advancing Value-Based Population Health Management Through Payer-Provider Partnerships: Improving Outcomes for Children with Complex Conditions	US	US; Pennsylvania		262 child patients, under 21,	Pediatrics, complex conditions	Pediatrics	Pediatric other	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Brown, M. M. Brown, G. C. Brown, H. C. Peet, J.	2008	A Value-Based Medicine Analysis of Ranibizumab for the Treatment of Subfoveal Neovascular Macular Degeneration	US	US; Pennsylvania		716 patients, classic or neovascular macular degeneration	Neovascular, macular degeneration, Subfoveal Neovascular Macular Degeneration	opthalmology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Burnhope, E. Waring, M. Guilder, A. Malhotra, B. Cardoso, J. M. Razavi, R. Cave-White, G.	2020	A systematic approach towards implementing value-based health care in heart failure: Understandings from retrospective analysis methods in South London	UK	UK; London		134 patients undergoing Implantable Cardioverter Defibrillator (ICD) or Cardiac Resynchronization	Cardiology, heart failure	Surgical	Cardiac/Thoracic	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		yes see second sheet
Khullar, O. V. Jiang, R. Force, S. D. Pickens, A. Sancheti, M. S. Ward, K. Gillespie, T.	2015	Transthoracic versus transhiatal resection for esophageal adenocarcinoma of the lower esophagus: A value-based comparison	US	US; Georgia		942 patients esophagectomy	Oncology, esophageal cancer	Oncology		full care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	Medicare costs, reimbursements	no
Ebinger, J. E. Strauss, C. E. Garberich, R. R. Bradley, S. M. Rush, P. Chavez, I. J. Poulose, A. K.	2018	Value-based ST-segment-elevation myocardial infarction care using risk-guided triage and early discharge	US	US; Minnesota		967 patients receiving primary percutaneous coronary intervention between 2009 and 2011	Cardiology, heart failure, myocardial infarction	Surgical	Cardiac/Thoracic	full care path (surgical episode)	Direct	provider	provider	unspecified; Hospital accounting data not otherwise specified	Unspecified	implemented		no
Bodar, Y. J. L. Srinivasan, A. K. Shah, A. S. Kawal, T. Shukla, A. R.	2020	Time-Driven activity-based costing identifies opportunities for process efficiency and cost optimization for robot-assisted laparoscopic pyeloplasty	US	US; Pennsylvania	single center, retrospective, direct observation	25 robot assisted laparoscopic pyeloplasties	Pediatrics, urology, robotics, robot	Pediatrics	Pediatric surgical	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Verberne, W. R. Dijkers, J. Kelder, J. C. Geers, A. B. M. Jellema, W. T. Vincent, H. H. Van Delden, J. J. M.	2018	Value-based evaluation of dialysis versus conservative care in older patients with advanced chronic kidney disease: A cohort study	The Netherlands	The Netherlands		366 patients aged ≥70 years with advanced chronic kidney disease	Nephrology, kidney, dialysis, chronic	Nephrology		full care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no

Gregory, D. Scotti, D. J. de Lissovoy, G. Palacios, I. Dixon, S. Maini, B. O'Neill, W.	2013	A value-based analysis of hemodynamic support strategies for high-risk heart failure patients undergoing a percutaneous coronary intervention	US	US; various states		427 patients enrolled in trial, mean age 68, 80.6% male	Cardiology, heart failure	Surgical	Cardiac/Thoracic	partial care path	Direct and indirect	provider (proxy)	payer		none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy		N/A	none, charges, cost to charges	no
Ravikumar, T. S. Sharma, C. Marini, C. Steele, G. D. Ritter, G. Barrera, R. Kim, M.	2010	A validated value-based model to improve hospital-wide perioperative outcomes: Adaptability to combined medical/surgical inpatient cohorts	US	US; New York		>100,000 hospital admissions	Surgical	Surgical	other	partial care path	Direct	provider	provider		direct variable costs as an estimation of total costs	Direct costing		Paper only		no
Ning, M. S. Venkatesan, A. M. Stafford, R. J. Bui, T. P. Carlson, R. Baillard, N. S. Madam, S.	2020	Developing an intraoperative 3T MRI-guided brachytherapy program within a diagnostic imaging suite: Methods, process workflow, and value-based analysis	US	US; Texas	single center, retrospective, direct observation, process mapping	10 female patients	Oncology, Gynecology, gynecologic pelvic tumor	Oncology		full care path (surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
Sun, L. L. Cao, D. Y. Yang, J. X. Bian, M. L. Wei, L. H. Shen, K.	2012	Value-based medicine analysis on loop electrosurgical excision procedure and CO2 laser vaporization for the treatment of cervical intraepithelial neoplasia 2	China	China		338 female patients, 18-65, colposcopic-histopathologically confirmed CIN2, intact uterus, no past history of cervical neoplasia, and had a	Obstetrics, Gynecology, cervical neoplasia	gynecology & obstetrics		partial care path	unspecified	provider	provider		unspecified	Unspecified		unspecified		no
Fortmann, A. L. Walker, C. Barger, K. Robacker, M. Morrisey, R. Ortwine, K. Lopez, J.	2020	Care Team Integration in Primary Care Improves One-Year Clinical and Financial Outcomes in Diabetes: A Case for Value-Based Care	US	US; California		236 treated patients, 239 usual care patients. All diagnosed with type 1 or 2 diabetes.	Diabetes	Internal Medicine		partial care path	Direct	provider	provider		direct variable costs as an estimation of total costs	Direct costing		implemented		no
Ramirez, M. M. Brennan, G. P.	2020	Using the value-based care paradigm to compare physical therapy access to care models in cervical spine radiculopathy: a case report	US	US; Florida		case study; 39 yo female	Physiotherapy	Neurology		partial care path	Direct and indirect	payer, patient	payer	patient	none, reimbursements	Charges/Reimbursement-based	Charges/Reimbursement-based patient OoO	N/A	cost to patient, reimbursement	no
Ryan, S. P. Plate, J. F. Black, C. S. Howell, C. B. Jiranek, W. A. Bolognesi, M. P. Seyler, T. M.	2019	Value-Based Care Has Not Resulted in Biased Patient Selection: Analysis of a Single Center's Experience in the Care for Joint Replacement Bundle	US	US; North Carolina		1248 total knee arthroplasty patients,	orthopedics, joint replacement, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	full care path	Direct	provider	provider		direct variable costs as an estimation of total costs	Direct costing		implemented		no
Plate, J. F. Ryan, S. P. Black, C. S. Howell, C. B. Jiranek, W. A. Bolognesi, M. P. Seyler, T. M.	2019	No Changes in Patient Selection and Value-Based Metrics for Total Hip Arthroplasty After Comprehensive Care for Joint Replacement Bundle Implementation at a Single Center	US	US; North Carolina		751 total hip arthroplasty patients,	orthopedics, joint replacement, total hip arthroplasty	Surgical	Orthopedic, arthroplasty	full care path	Direct	provider	provider		direct variable costs as an estimation of total costs	Direct costing		implemented		no
Abbott, M. M. Meara, J. G.	2011	A microcosting approach for isolated, unilateral cleft lip care in the first year of life	US	US; Massachusetts	single center, retrospective	12 children, cleft lip repair	Pediatrics, cleft palate, plastic surgery	Pediatrics	Pediatric Plastic surgery	partial care path (full surgical episode)	Direct and indirect	provider	provider		Microcosting	Absorption costing - ABC		Paper only		yes see second sheet
Regan, D. K. Manoli, A. Hutzler, L. Konda, S. R. Egol, K. A.	2015	Impact of Diabetes Mellitus on Surgical Quality Measures After Ankle Fracture Surgery: Implications for "Value-Based" Compensation and "Pay for Performance"	US	US; New York		58,748 patients, 7501 with Diabetes Mellitus	Diabetes	Internal Medicine		unspecified	Direct and indirect	payer	payer		none, reimbursements	Charges/Reimbursement-based		N/A	mean total hospital charges	no
Yu, Y. R. Abbas, P. I. Smith, C. M. Carberry, K. E. Ren, H. Patel, B. Nightingale, J. G.	2017	Time-driven activity-based costing: A dynamic value assessment model in pediatric appendicitis	US	US; Texas	single center, retrospective, direct observation, process mapping	207 patients total, 6 phases of care	Pediatrics, appendicitis, simple appendicitis	Pediatrics	Pediatric appendicitis	full care path (surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
Rice-Townsend, S. Barnes, J. N. Hall, M. Baxter, J. L. Rangel, S. J.	2014	Variation in practice and resource utilization associated with the diagnosis and management of appendicitis at freestanding children's hospitals: Implications for value-based comparative analysis	US	US; Massachusetts		13,328 patients, 34 children's hospitals, 25 states in US, acute appendicitis, age 3-18	Pediatrics, appendicitis	Pediatrics	Pediatric appendicitis	unspecified	Direct and indirect	payer	payer		none, reimbursements	Charges/Reimbursement-based		N/A	charges transformed with cost-to-charge ratio	no
Ahluwalia, R. Cook, J. Raheman, F. Karuppaiah, K. Colegate-Stone, T. Tavakkolizadeh, A. Kaneriya, M.	2020	Improving the efficiency of ankle fracture care through home care and day-surgery units: Delivering safe surgery on a value-based healthcare model	UK	UK; London	single center, prospective, process mapping	53 trauma patients	trauma, orthopedics, surgical, ankle fracture	Surgical	Orthopedic fracture	full care path (surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
Basto, J. Chahal, R., Riedel, B.	2019	Time-driven activity-based costing to model the utility of parallel induction redesign in high-turnover operating lists	Australia	Australia	single center, prospective, process mapping	19 all-day surgery lists, patients unspecified	melanoma, oncology	Oncology		partial care path (partial surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		Paper only		yes see second sheet

Kadakia, R. J., Ahearn, B.M., Tenenbaum, S., Bariteau, J.T.	2017	Costs Associated With Geriatric Ankle Fractures, Operative Versus Nonoperative Management	US	US; Georgia		19648 ankle fracture patients	trauma, orthopedics, geriatrics, ankle fracture	Surgical	Orthopedic fracture	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	medicare reimbursements	no
Barkley, R. Soobader, M. J. Wang, J. Blau, S. Page, R. D.	2019	Reducing Cancer Costs Through Symptom Management and Triage Pathways	US	US; Florida		10417 ER Events, 1879 unique patients	Emergency care, Acute care, Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	medicare claims	no
McLaughlin, N. Martin, N. A. Upadhyaya, P. Bari, A. A. Buxey, F. Wang, M. B. Heaney, A. P.	2014	Assessing the cost of contemporary pituitary care	US	US; California	single center, retrospective	27 neurosurgical patients	Neurosurgical, pituitary adenoma	Surgical	Neurosurgery	partial care path (full surgical episode)	Direct and indirect	provider	provider	ABC	Absorption costing - ABC	implemented		yes see second sheet
Hersh, E. H. Yaeger, K. A. Neifert, S. N. Kim, J. Dangayach, N. S. Weiss, N.	2019	Patterns of Health Care Costs Due to External Ventricular Drain Infections	US	US; New York		External ventricular drain (EVD) infection patients	Neurosurgery	Surgical	Neurosurgery	partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	implemented		no
Meara, J. G. Hughes, C. D. Sanchez, K. Catallozzi, L. Clark, R. Kummer, A. W.	2020	Optimal Outcomes Reporting (OOR): A New Value–Based Metric for Outcome Reporting Following Cleft Palate Repair	US	US; Massachusetts	Retrospective, single-center cohort analysis	94 patients were identified who underwent primary cleft palate repair by the same surgeon	Cleft palate, Palatoplasty, plastic surgery	Surgical	Plastic surgery	full care path	Direct and indirect	provider	provider	Relative Value Units	Absorption costing - unspecified/generic	Paper only		no
Jakovljevic, M. Zugic, A. Rankovic, A. Dagovic, A.	2015	Radiation therapy remains the key cost driver of oncology inpatient treatment	Serbia	Serbia		2544 complex oncology patients	Oncology	Oncology		partial care path	Direct	provider	provider	Microcosting direct costs only	Direct costing	unspecified		no
Suidan, R. S. He, W. Sun, C. C. Zhao, H. Rauh-Hain, J. A. Fleming, N. D. Lu, K. H.	2019	Total and out-of-pocket costs of different primary management strategies in ovarian cancer	US	US; Texas		12761 patients	Gynecology, oncology, ovarian cancer	gynecology & obstetrics		unspecified	Direct and indirect	Payer, patient	payer	patient	none, reimbursements	Charges/Reimbursement-based	Charges/Reimbursement-based patient OoO	N/A	charges	no
Lenfant, L. Sawczyn, G. Kim, S. Aminsharifi, A. Kaouk, J.	2020	Single-institution Cost Comparison: Single-port Versus Multiport Robotic Prostatectomy	US	US; Ohio	Retrospective, single-center cohort	175 patients	Oncology, prostate cancer, surgical	Oncology		partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		yes see second sheet
Hemmila, M. R. Cain-Nielsen, A. H. Wahl, W. L. Vander Kolk, W. E. Jakubus, J. L. Mikhail, J. N. Rickmeyer, N. J.	2014	Regional collaborative quality improvement for trauma reduces complications and costs	US	US; Texas		72084 episodes of acute trauma care	Acute care	emergency care & acute care		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	price-standardized payments, claims, DRG prices	no
AlAshqar, A. Goktepe, M. E. Kilic, G. S. Borahay, M. A.	2021	Predictors of the cost of hysterectomy for benign indications	US	US; Maryland		1847 female hysterectomy patients	gynecology, obstetrics, Vaginal hysterectomy	gynecology & obstetrics		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Naghavi, A. O. Gonzalez, R. J. Scott, J. G. Kim, Y. Abuodeh, Y. A. Strom, T. J. Eshaywarria, M.	2017	Staged reconstruction brachytherapy has lower overall cost in recurrent soft-tissue sarcoma	US	US; Florida		22 soft-tissue sarcoma patients	Oncology, soft-tissue sarcoma	Oncology		full care path	unspecified	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Puvanesarajah, V. Kirby, D. J. Jain, A. Werner, B. C. Hassanzadeh, H.	2017	Cost Variation of Anterior Cervical Fusions in Elderly Medicare Beneficiaries	US	US; unspecified		21,853 patients	orthopedics, geriatrics, elective anterior cervical fusions	Surgical	Orthopedic fracture	unspecified	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Siu, A. Patel, J. Prentice, H. A. Cappuzzo, J. M. Hashemi, H. Mukherjee, D.	2017	A Cost Analysis of Regional Versus General Anesthesia for Carotid Endarterectomy	US	US; Virginia		346 patients	Neurosurgery, anasthesia, carotid endarterectomy	Surgical	Neurosurgery	unspecified	direct	provider	provider	unspecified	Direct costing	implemented		no
Kirsch, D. B. Yang, H. Maslow, A. L. Stolzenbach, M. McCall, A.	2019	Association of Positive Airway Pressure Use With Acute Care Utilization and Costs	US	US; North Carolina		1098 patients	Sleep medicine, sleep apnea, Obstructive Sleep Apnea	Internal Medicine		partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	implemented		no

Passias, P. G. Poorman, G. W. Bortz, C. A. Qureshi, R. Diebo, B. G. Paul, J. C. Horn, S. R.	2018	Predictors of adverse discharge disposition in adult spinal deformity and associated costs	US	US; New York		2408 patients	orthopedic, surgical	Surgical	Spine	partial care path	unspecified	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Monroe, G. R. Frederix, G. W. Savelberg, S. M. C. De Vries, T. I. Duran, K. J. Van Der Smagt, J. J. Terhal, P. A.	2016	Effectiveness of whole-exome sequencing and costs of the traditional diagnostic trajectory in children with intellectual disability	The Netherlands	The Netherlands		17 patients	Genetics, Pediatrics, Intellectual disability	Pediatrics	Pediatric other	full care path	Direct	provider	provider	bottom-up clinical costing approach	Direct costing	implemented		no
Manrriquez, E. Mandelbaum, A. Aguayo, E. Zakhour, M. Karlan, B. Benharash, P. Cohen, J. G.	2020	Factors associated with high-cost hospitalizations in elderly ovarian cancer patients	US	US; Virginia		21853 patients	Geriatrics, oncology, ovarian cancer, anterior cervical discectomy and fusion, anterior cervical fusion, cervical spine, cervical spondylosis	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursement	no
Wise, K. Blaschke, B. L. Parikh, H. R. Gorman, T. Casnovsky, L. McMilan, L. J. Thornhill, J.	2020	Variation of the Inpatient Cost of Care in the Treatment of Isolated Geriatric Intertrochanteric Hip Fractures	US	US; Minnesota	single center, retrospective	287 patients	orthopedics, geriatrics, hip fracture, surgical	Surgical	Orthopedic fracture	partial care path (full surgical episode)	Direct and indirect	provider	provider	ABC	Absorption costing - ABC	implemented		yes see second sheet
Rocque, G. B. Williams, C. P. Jackson, B. E. Ingram, S. A. Halilova, K. I. Pisu, M. Kenzik, K. M.	2018	Resource Use and Medicare Costs During Lay Navigation for Geriatric Patients With Cancer	US	US; Alabama		988 patients	Geriatrics, oncology, De Novo Metastatic Breast Cancer	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursement	no
Schwartz, D. A. Shah, A. A. Zogg, C. K. Nicholas, L. H. Velopulos, C. G. Efron, D. T. Schneider, E. B.	2015	Operative delay to laparoscopic cholecystectomy: Racking up the cost of health care	US	US; Massachusetts		191032 patient records	Surgical, acute care, acute cholecystitis, aparoscopic cholecystectomy	Surgical	Gallbladder	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Brixner, D. Rubin, D. T. Mease, P. Mittal, M. Liu, H. Davis, M. Gascoyne, A.	2019	Patient support program increased medication adherence with lower total health care costs despite increased drug spending	US	US; various states		1134 patients	Multiple	multiple		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Aguayo, E. Sanaiha, Y. Seo, Y. J. Mardock, A. Bailey, K. Dobaria, V. Benharash, P.	2018	Heparin-induced thrombocytopenia in cardiac surgery: Incidence, costs, and duration of stay	US	US; California		13943 patients	Cardiology, surgical, thrombocytopenia, Heparin-induced thrombocytopenia	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	payer	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Cronin, K. J. Mair, S. D. Hawk, G. S. Thompson, K. L. Hettrich, C. M. Jacobs, C. A.	2020	Increased Health Care Costs and Opioid Use in Patients with Anxiety and Depression Undergoing Rotator Cuff Repair	US	US; Kentucky		170329 patients	orthopedic, surgical, depression, Rotator Cuff Repair	Surgical	Orthopedic rotator cuff repair	partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Alli, V. V. Zhang, J. Telem, D. A.	2018	Impact of incisional hernia development following abdominal operations on total healthcare cost	US	US; Texas		14290 patients	Surgical, hernia, Incisional hernia	Surgical	Abdominal	full care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Robles, A. J. Kornblith, L. Z. Hendrickson, C. M. Howard, B. M. Conroy, A. S. Moazed, F. Calfee, C. S.	2018	Health care utilization and the cost of posttraumatic acute respiratory distress syndrome care	US	US; California		1552 patients	Acute care, trauma care	emergency care & acute care		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
van Dijck, J. T. J. M. van Essen, T. A. Dijkman, M. D. Mostert, C. Q. B. Polinder, S. Peul, W. C. de Ruiter, G. C. W.	2019	Functional and patient-reported outcome versus in-hospital costs after traumatic acute subdural hematoma (t-ASDH): a neurosurgical paradox?	The Netherlands	The Netherlands		108 patients	Acute care, brain injury, acute subdural hematoma, trauma care	emergency care & acute care		partial care path	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic	Paper only		no
Thakore, R. V. Greenberg, S. E. Shi, H. Foxx, A. M. Francois, E. L. Prablek, M. A. Nguyen, S. K.	2015	Surgical site infection in orthopedic trauma: A case-control study evaluating risk factors and cost	US	US; Tennessee		78 patients	orthopedic, surgical	Surgical	Orthopedic	unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Smith, B. D. Jiang, J. Shih, Y. C. Giordano, S. H. Huo, J. Jagsi, R. Momoh, A. O.	2017	Cost and complications of local therapies for early-stage breast cancer	US	US; Texas		105 211 female patients	Oncology, breast cancer	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no

Lentz, T. A. Rhon, D. I. George, S. Z.	2020	Predicting Opioid Use, Increased Health Care Utilization and High Costs for Musculoskeletal Pain: What Factors Mediate Pain Intensity and Disability?	US	US; Washington		283 patients	Pain, Musculoskeletal Pain	Pain medicine		partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		no
Kaul, S. Korgenski, E. K. Ying, J. Ng, C. F. Smits-Seemann, R. R. Nelson, R. E. Andrews, S.	2016	A retrospective analysis of treatment- related hospitalization costs of pediatric, adolescent, and young adult acute lymphoblastic leukemia	US	US; Utah	single center, retrospective	505 patients	Oncology, leukemia, acute lymphoblastic leukemia	Pediatrics	Pediatric Oncology	partial care path	Direct and indirect	provider	provider	ABC	Absorption costing - ABC	implemented		no
Silva-Velazco, J. Dietz, D. W. Stocchi, L. Costedio, M. Gorgun, E. Kalady, M. F. Kessler, H.	2017	Considering Value in Rectal Cancer Surgery: An Analysis of Costs and Outcomes Based on the Open, Laparoscopic, and Robotic Approach for Proctectomy	US	US; Ohio		488 patients	Oncology, rectal cancer	Oncology		partial care path (surgical episode)	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		no
Canizares, M. F. Feldman, L. Miller, P. E. Waters, P. M. Bae, D. S.	2017	Complications and Cost of Syndactyly Reconstruction in the United States: Analysis of the Pediatric Health Information System	US	US; Massachusetts		38 hospitals, 2047 procedures	Pediatrics, orthopedic, surgical, Syndactyly Reconstruction	Pediatrics	Pediatric surgical	partial care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Vuong, B Dehal, A Uppal, A Stern, S L Mejia, J Weerasinghe, R Kapoor, V	2018	What Are the Most Significant Cost and Value Drivers for Pancreatic Resection in an Integrated Healthcare System?	US	US; California		796 patients	Surgical, Pancreas, Pancreatic Resection	Surgical	Endocrine	partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		no
Sanaiha, Y. Mantha, A. Ziacian, B. Juo, Y. Y. Shemin, R. J. Benharash, P.	2020	Trends in Readmission and Costs After Transcatheter Implantation Versus Surgical Aortic Valve Replacement in Patients With Renal Dysfunction	US	US; LA		350,609 isolated aortic valve replacements	Cardiology, Renal, Aortic Repair, Thoracic Endovascular Aortic Repair	Surgical	Cardiac/Thoracic	partial care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Chatfield, S. C. Volpicelli, F. M. Adler, N. M. Kim, K. L. Jones, S. A. Francois, F. Shah, R. C.	2019	Bending the cost curve: time series analysis of a value transformation programme at an academic medical centre	US	US; New York	single center, retrospective	74 projects, 160434 patients,	Multiple	multiple		partial care path	Direct	provider	provider	ABC	Direct costing	implemented		yes see second sheet
Chawla, S. S. Whitson, A. J. Schiffman, C. J. Matsen, F. A. Hsu, J. E.	2020	Drivers of lower inpatient hospital costs and greater improvements in health-related quality of life for patients undergoing total shoulder and ream-and-run arthroplasty	US	US; Washington		433 patients	orthopedics, athroplasty, total shoulder and ream-and-run arthroplasty	Surgical	Orthopedic, arthroplasty	unspecified	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Klink, A. J. Chmielowski, B. Feinberg, B. Ahsan, S. Nero, D. Liu, F. X.	2019	Health Care Resource Utilization and Costs in First-Line Treatments for Patients with Metastatic Melanoma in the United States	US	US; various states		1599 patients	Oncology, melanoma	Oncology		unspecified	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	claims	no
Chotai, S. Sivaganesan, A. Parker, S. L. Sielatycki, J. A. McGirt, M. J. Devin, C. J.	2018	Drivers of Variability in 90-Day Cost for Elective Anterior Cervical Discectomy and Fusion for Cervical Degenerative Disease	US	US; Tennessee		445 patients	Spine, cervical degenerative disease	Surgical	Spine	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Sanaiha, Y. Kavianpour, B. Downey, P. Morchi, R. Shemin, R. J. Benharash, P.	2020	National Study of Index and Readmission Mortality and Costs for Thoracic Endovascular Aortic Repair in Patients With Renal Disease	US	US; California		121046 patients	Cardiology, Surgical, Aortic repair, Renal Disease	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Jain, N. Brock, J. L. Phillips, F. M. Weaver, T. Khan, S. N.	2018	Chronic preoperative opioid use is a risk factor for increased complications, resource use, and costs after cervical fusion	US	US; various states		29101 patients	Spine, cervical degenerative disease	Surgical	Spine	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Featherall, J. Brigati, D. P. Arney, A. N. Faour, M. Bokar, D. V. Murray, T. G. Molloy, R. M.	2019	Effects of a Total Knee Arthroplasty Care Pathway on Cost, Quality, and Patient Experience: Toward Measuring the Triple Aim	US	US; Ohio		6760 surgeries	orthopedics, total knee athroplasty	Surgical	Orthopedic, arthroplasty	full care path (surgical episode)	Direct	provider	provider	Relative Value Unit costing	Direct costing	implemented		yes see second sheet
Ackerman, R. S. Hirschi, M. Alford, B. Evans, T. Kiluk, J. V. Patel, S. Y.	2019	Enhanced REVENUE After Surgery? A Cost-Standardized Enhanced Recovery Pathway for Mastectomy Decreases Length of Stay	US	US; unspecified		103 patients	Oncology, mastectomy	Oncology		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no

Williams, S. B. Shan, Y. Jazzar, U. Mehta, H. B. Baillargeon, J. G. Huo, J. Sonagnora, A. J.	2018	Comparing Survival Outcomes and Costs Associated With Radical Cystectomy and Trimodal Therapy for Older Adults With Muscle-Invasive Bladder Cancer	US	US; various states		3200 patients	Oncology, urology, surgical, bladder cancer	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Schilling, P. L. He, J. Chen, S. Placzek, H. Bini, S. A.	2020	Risk-Adjusted Cost Performance for 90-Day Total Hip Arthroplasty Episodes: Comparing US Hospitals Nationwide Before CJR	US	US; various states		366380 patients	Surgical	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Lott, A. Haglin, J. Saleh, H. Hall, J. Egol, K. A. Konda, S. R.	2018	Using a Validated Middle-Age and Geriatric Risk Tool to Identify Early (48 Hours) Hospital Mortality and Associated Cost of Care	US	US; various states		1486 patients	Acute care, geriatrics, Emergency care	emergency care & acute care		partial care path	Direct	provider	provider	unspecified; Hospital accounting data not otherwise specified	Direct costing	implemented		no
Ackerman, S. J. Knight, T. Wahl, P. M. Cartwright, C. P.	2019	Health care utilization and costs following amplified versus non-amplified molecular probe testing for symptomatic patients with suspected vulvovaginitis: A us commercial payer population	US	US; various states		313145 patients	Gynecology, obstetrics, vulvocvaginitis	gynecology & obstetrics		unspecified	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Peard, L. Goodwin, J. Hensley, P. Dugan, A. Bylund, J. Harris, A. M.	2019	Examining and Understanding Value: The Impact of Preoperative Characteristics, Intraoperative Variables, and Postoperative Complications on Cost of Robot-Assisted Laparoscopic Radical Prostatectomy	US	US; Kentucky		275 patients	Surgical, robot, Robot-Assisted Laparoscopic Radical Prostatectomy	Surgical	Prostatectomy	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Patel, M. I. Ramirez, D. Agajanian, R. Agajanian, H. Bhattacharya, J. Bundorf, K. M.	2020	Lay health worker-led cancer symptom screening intervention and the effect on patient-reported satisfaction, health status, health care use, and total costs: Results from a tri-part collaboration	US	US; California		425 enrollees	Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Harris, A. M. Hensley, P. Goodwin, J. Dugan, A. Peard, L. Bell, J. R. Bholadi, A.	2019	Examining and Understanding Value: The Cost of Preoperative Characteristics, Intraoperative Variables and Postoperative Complications of Minimally Invasive Partial Nephrectomy	US	US; Kentucky		215 patients	Urology, surgical, Nephrectomy	Surgical	kidney	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Stearns, L. J. Narang, S. Albright, R. E. Hammond, K. Xia, Y. Richter, H. B. Buyamoradnia, G. K.	2019	Assessment of Health Care Utilization and Cost of Targeted Drug Delivery and Conventional Medical Management vs Conventional Medical Management Alone for Patients With Cancer-Related Pain	US	US; various states		5215 patients	Oncology, Pain, pain management	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
McCreary, D. L. Dugarte, A. J. Vang, S. Plowman, B. Williams, B. R. Parikh, H. R. Cunningham, B. P.	2019	Patient-Level Value Analysis: An Innovative Approach to Optimize Care Delivery	US	US; Minnesota	single center, prospective, process mapping	67 patients	orthopedics	Surgical	Orthopedic fracture	partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Caloway, C. Yamasaki, A. Callans, K. M. Shah, M. Kaplan, R. S. Hartnick, C.	2020	Quantifying the benefits from a care coordination program for tracheostomy placement in neonates	US	US; Massachusetts	single center, retrospective, direct observation, pre and post comparison	10 patients	Neonatal, pediatrics, tracheostomy, surgical	Pediatrics	Pediatric Neonatal	partial care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Navarro, S. M. Wang, E. Y. Haeberle, H. S. Mont, M. A. Krebs, V. E. Patterson, B. M. Ramkumar, P. N.	2018	Machine Learning and Primary Total Knee Arthroplasty: Patient Forecasting for a Patient-Specific Payment Model	US	US; New York		141446 patients	orthopedics, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	partial care path (surgical episode)	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Skill, N. J. Butler, J. O'Brien, D. C. Kays, J. K. Kubal, C. Liangpunsakul, S. Sinogl, N.	2019	Financial Burden of Liver Transplant vs Resection for Hepatocellular Carcinoma	US	US; Indiana		44 patients	Oncology, renal	Oncology		partial care path	Direct and indirect	provider (proxy)	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Robinson, Jamie R. Avritscher, Elenir B.C. Gay, James C. Willis, Zachary I. Putnam, Luke R. Anglemyer, Andrew Bakaev, Claudia	2017	Measuring the Value of a Clinical Practice Guideline for Children With Perforated Appendicitis	US	US; Tennessee		313 patients	Appendicitis, Pediatrics	Pediatrics	Pediatric appendicitis	partial care path (surgical episode)	Direct and indirect	provider, payer	provider	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	Absorption costing - unspecified/generic	N/A	charges	no
Lahovitz, J. M. Kominski, G. F.	2016	Forecasting the Value of Podiatric Medical Care in Newly Insured Diabetic Patients During Implementation of the Affordable Care Act in California	US	US; California		unspecified	Diabetes	Internal Medicine		unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no

Johnson, J. T. Scholtens, D. M. Kuang, A. Feng, X. Y. Eltayeb, O. M. Post, L. A. Marino, B. S.	2020	Does value vary by center surgical volume for neonates with truncus arteriosus? A multicenter study	US	US; various states	1024 neonates	Neonatal, pediatrics, surgical, cardiology, thoracic surgery	Pediatrics	Pediatric Neonatal	full care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Karnuta, J. M. Navarro, S. M. Haeberle, H. S. Helm, J. M. Kamath, A. F. Schaffer, J. L. Krebs, V. E.	2019	Predicting Inpatient Payments Prior to Lower Extremity Arthroplasty Using Deep Learning: Which Model Architecture Is Best?	US	US; New York	295605 patients	orthopedics, total hip arthroplasty, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	payment, cost to payor	no
Saifi, C. Cazzulino, A. Park, C. Laratta, J. Louie, P. K. Shillingford, J. N. Lehman, R.	2018	National Trends for Primary and Revision Lumbar Disc Arthroplasty Throughout the United States	US	US; various states	12957 patients	Athroplasty	Surgical	Orthopedic, arthroplasty	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Ning, M. S. Palmer, M. B. Shah, A. K. Chambers, L. C. Garlock, L. B. Melson, B. B. Kraik, C. L.	2020	Three-year results of a prospective statewide insurance coverage pilot for proton therapy: Stakeholder collaboration improves patient access to care	US	US; Texas	32 patients	Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Mukdad, L. Mantha, A. Aguayo, E. Sanaiha, Y. Juo, Y. Y. Ziaeian, B. Shemin, R. J.	2018	Readmission and resource utilization after orthotopic heart transplant versus ventricular assist device in the National Readmissions Database, 2010–2014	US	US; California	12111 patients	Thoracic surgery, Cardiology, heart failure, heart transplant, VADs	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Frankel, W. C. Navarro, S. M. Haeberle, H. S. Ramanathan, D. Ramkumar, P. N.	2019	Optimizing the Volume-Value Relationship in Laminectomy: An Evidence-Based Analysis of Outcomes and Economies of Scale	US	US; New York	67758 patients	orthopedic, laminectomy, surgical	Surgical	Spine	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Boucek, D. M. Lal, A. K. Eckhauser, A. W. Weng, H. Y. C. Sheng, X. Wilkes, J. F. Pinto, N. M.	2018	Resource Utilization for Initial Hospitalization in Pediatric Heart Transplantation in the United States	US	US; Pennsylvania	1629 patients	Pediatrics, cardiology	Pediatrics	Pediatric surgical	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Keller, D. S. Zhang, J. Chand, M.	2019	Opioid-free colorectal surgery: a method to improve patient & financial outcomes in surgery	US	US; various states	50098 cases	Surgical, Laparoscopic colorectal surgery	Surgical	Colon/Rectal	unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Reilly, R. F.	2020	Creating a Value Dashboard for orthopedic Surgical Procedures	Lebanon	Lebanon	6 surgeons' data	Orthopeadics, total knee arthroplasty, total hip arthroplasty	Surgical	Orthopedic, arthroplasty	unspecified	Direct	provider	provider	unspecified; Hospital accounting data not otherwise specified	Direct costing	implemented		no
Miller, P. E. Guha, A. Khera, R. Chouairi, F. Ahmad, T. Nasir, K. Addison, D.	2019	National Trends in Healthcare-Associated Infections for Five Common Cardiovascular Conditions	US	US; various states	17889852 hospitalizations	Cardiology, cardiovascular	Cardiology		unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Konda, Sanjit R. Lott, Ariana Egol, Kenneth A.	2018	The coming hip and femur fracture bundle: A new inpatient risk stratification tool for care providers	US	US; New York	173 patients	Orthopeadics, Geriatrics, total hip arthroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct	provider	provider	unspecified; Hospital accounting data not otherwise specified	Direct costing	implemented		no
Winegar, A. L. Jackson, L. W. Sambare, T. D. Liu, T. C. Banks, S. R. Erlinger, T. P. Schultz, W. B.	2019	A Surgeon Scorecard Is Associated with Improved Value in Elective Primary Hip and Knee Arthroplasty	US	US; Texas	470 patients	Surgical, total hip arthroplasty, knee arthroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Rocque, G. B. Williams, C. P. Kenzik, K. M. Jackson, B. E. Halilova, K. I. Sullivan, M. M. Roussos, P. P.	2017	Where Are the Opportunities for Reducing Health Care Spending Within Alternative Payment Models?	US	US; Alabama	3427 patients from 12 cancer centers	Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Laratta, J. L. Reddy, H. Lombardi, J. M. Shillingford, J. N. Saifi, C. Fischer, C. R. Lehman, R. A.	2018	Utilization of Interspinous Devices Throughout the United States Over a Recent Decade: An Analysis of the Nationwide Inpatient Sample	US	US; various states	14225 patients	Surgical, spine	Surgical	Spine	partial care path (surgical episode)	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Karnuta, J. M. Golubovsky, J. L. Haeberle, H. S. Rajan, P. V. Navarro, S. M. Kamath, A. F. Schaffer, J. L.	2020	Can a machine learning model accurately predict patient resource utilization following lumbar spinal fusion?	US	US; various states	38070 patients	Spine, lumbar spinal fusion	Surgical	Spine	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no

Karnuta, J. M. Navarro, S. M. Haeberle, H. S. Billow, D. G. Krebs, V. E. Ramkumar, P. N.	2019	Bundled Care for Hip Fractures: A Machine-Learning Approach to an Untenable Patient-Specific Payment Model	US	US; New York	98562 patients	orthopedics, hip fracture, trauma	Surgical	Orthopedic fracture	partial care path	Direct and indirect	provider (proxy)	payer	none; estimation, cost-to-charge ratio, SPARCS data	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Cremins, M. Vellanky, S. McCann, G. Mancini, M. Sanzari, L. Yannopoulos, A.	2020	Considering healthcare value and associated risk factors with postoperative urinary retention after elective laminectomy	US	US; Conneticut	433 patients	surgical, elective laminectomy	Surgical	Spine	partial care path	Direct	provider	provider	direct costs	Direct costing	unspecified		no
Navarro, S. M. Ramkumar, P. N. Egger, A. C. Goodwin, R. C.	2018	Evidence-Based Thresholds for the Volume-Value Relationship in Adolescent Idiopathic Scoliosis: Outcomes and Economies of Scale	US	US; New York	3224 patients	Orthopoedic, Pediatrics, Adolescent Idiopathic Scoliosis	Pediatrics	Pediatric other	partial care path	Direct and indirect	provider (proxy)	payer	none; estimation, cost-to-charge ratio, SPARCS data	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Bateni, S. B. Gingrich, A. A. Hoch, J. S. Canter, R. J. Bold, R. J.	2019	Defining Value for Pancreatic Surgery in Early-Stage Pancreatic Cancer	US	US; California	2786 patients, 157 hospitals	Oncology, pancreatic cancer	Oncology		unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Xiao, R. Miller, J. A. Zafirau, W. J. Gorodeski, E. Z. Young, J. B.	2018	Impact of Home Health Care on Health Care Resource Utilization Following Hospital Discharge: A Cohort Study	US	US; unspecified	6363 patients	Multiple	multiple		partial care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Ramshaw, B. Forman, B. R. Moore, K. Heidel, E. Fabian, M. Mancini, G. Joshi, G. P.	2017	Real-World Clinical Quality Improvement for Complex Abdominal Wall Reconstruction	US	US; Texas	102 patients	Surgical, complex abdominal wall reconstruction	Surgical	Abdominal	full care path (surgical episode)	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	implemented		no
Heincelman, M. Schumann, S. O. Riley, J. Zhang, J. Marsden, J. E. Mauldin, P. D. Rookey, D. C.	2016	Identification of High Utilization Inpatients on Internal Medicine Services	US	US; unspecified	7571 patients	Internal medicine	Internal Medicine		unspecified	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	implemented		no
Sheetz, K. H. Kenney, B. Dupree, J. M. Campbell, D. A. Englesbe, M. J.	2019	Targeting Value-Driven Quality Improvement for Laparoscopic Cholecystectomy in Michigan	US	US; Michigan	19213 patients	Surgical, Laparoscopic Cholecystectomy	Surgical	Gallbladder	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Zolin, S. J. Tastaldi, L. Alkhatib, H. Lampert, E. J. Brown, K. Fafaj, A. Petro, C. C.	2020	Open retromuscular versus laparoscopic ventral hernia repair for medium-sized defects: where is the value?	US	US; various states	All medicare shoulder surgeries 2002-2018	orthopedics, Surgical, Shoulder surgery	Surgical	Abdominal	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Ahluwalia, R. Vainieri, E. Tam, J. Sait, S. Sinha, A. Manu, C. A. Reichert, I.	2019	Surgical Diabetic Foot Debridement: Improving Training and Practice Utilizing the Traffic Light Principle	UK	UK; London	single center, retrospective, direct observation, pre and post comparison	53 patients	Surgical, diabetic foot infection, diabetes	Surgical	Diabetes	partial care path (full surgical episode)	Direct and indirect	payer	payer	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Ramly, E. P. Larentzakis, A. Bohnen, J. D. Mavros, M. Chang, Y. Lee, J. Yeh, D. D.	2015	The financial impact of intraoperative adverse events in abdominal surgery	US	US; Massachusetts	9111 patients	surgical, abdominal surgery	Surgical	Abdominal	unspecified	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	implemented		no
Orhurhu, V. Urits, I. Olusunmade, M. Owais, K. Jones, M. Galasso, A. Solim Orhurhu, M.	2018	Trends of Co-Morbid Depression in Hospitalized Patients with Failed Back Surgery Syndrome: An Analysis of the Nationwide Inpatient Sample	US	US; unspecified	115976 patients	Surgical, depression, psychiatry	Pain medicine		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A		no
Hollenbeck, B. Hoffman, M. A. Tromanhauser, S. G.	2020	High-Volume Arthroplasty Centers Demonstrate Higher Composite Quality Scores and Enhanced Value: Perspective on Higher-Volume Hospitals Performing Arthroplasty from 2001 to 2011	US	US; various states	1651354 total hip or total knee arthroplasties	orthopedics, surgical, total hip arthroplasty, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	unspecified	Direct and indirect	provider (proxy)	payer	none; charges	Charges/Reimbursement-based	N/A	charges per quartile, discuss how it should be costs in discussion	no
Loftus, T. J. Rosenthal, M. D. Croft, C. A. Stephen Smith, R. Efron, P. A. Moore, F. A. Mohr, A. M.	2018	Effect of Time to Operation on Value of Care in Acute Care Surgery	US	US; Florida	800 patients	Acute care, appendicitis, surgical, laparotomy for intra-abdominal sepsis with temporary abdominal closure	Surgical	Appendicitis	full care path (surgical episode)	unspecified	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges, discuss shortcoming in discussion	no

Buell, J. F. Sigmon, D. Ducoin, C. Shapiro, M. Teja, N. Wynter, E. Hanisee, M. K.	2017	Initial Experience with Biologic Polymer Scaffold (Poly-4-hydroxybuturate) in Complex Abdominal Wall Reconstruction	US	US; Louisiana		73 patients	Surgical, complex abdominal wall reconstruction	Surgical	Abdominal	full care path (surgical episode)	unspecified	payer	payer	none; charges	Charges/Reimbursement-based	N/A		no
Jain, N. Phillips, F. M. Shimer, A. L. Khan, S. N.	2018	Surgeon Reimbursement Relative to Hospital Payments for Spinal Fusion	US	US; various states		40965 patients	Surgical	Surgical	Spine	unspecified	unspecified	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Stull, J. D. Bhat, S. B. Kane, J. M. Raikin, S. M.	2017	Economic Burden of Inpatient Admission of Ankle Fractures	US	US; unspecified		76 cases/patients, and 48044 retrospective patient files	orthopedics, Surgical, ankle fractures	Surgical	Orthopedic fracture	unspecified	unspecified	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursement	no
Lewis, R. B. Hariri, O. Elliott, M. E. Jo, C. H. Ramo, B. A.	2020	Financial Analysis of Closed Femur Fractures in 3- to 6-Year-Olds Treated with Immediate Spica Casting Versus Intramedullary Fixation	US	US; Texas		114 patients	orthopedic, surgical, pediatrics	Pediatrics	Pediatric surgical	full care path	unspecified	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Murphy, W. S. Cheng, T. Lin, B. Terry, D. Murphy, S. B.	2019	Higher Volume Surgeons Have Lower Medicare Payments, Readmissions, and Mortality after THA	US	US; Massachusetts		409,844 cases	orthopedics, total hip athroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Geerdink, T. H. Haverlag, R. van Veen, R. N. Bouwmeester, O. V. A. Goslings, J. C.	2020	Direct discharge from the ED for patients with simple stable injuries: a Dutch pilot study	The Netherlands	The Netherlands		275 patients	Acute care, emergency care	emergency care & acute care		partial care path	direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic	unspecified		no
Martin, J. A. Mayhew, C. R. Morris, A. J. Bader, A. M. Tsai, M. H. Urman, R. D.	2018	Using Time-Driven Activity-Based Costing as a Key Component of the Value Platform: A Pilot Analysis of Colonoscopy, Aortic Valve Replacement and Carpal Tunnel Release Procedures	US	US; Vermont	multi center, retrospective, process mapping, pilot projects (3)	3 pilot studies	Surgical, cardiology, aortic valve replacement	Surgical	Cardiac/Thoracic	partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		yes see second sheet
Abdulla, A. G. Ituarte, P. H. Wiggins, R. Teisberg, E. O. Harari, A. Yeh, M. W.	2012	Endocrine surgery as a model for value-based health care delivery	US	US; California		44631 patients	Surgical, neurological	Surgical	Endocrine	unspecified	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
King, A. M. Danagoulian, S. Lynch, M. Menke, N. Mu, Y. Saul, M. Abaseerie, M.	2019	The Effect of a Medical Toxicology Inpatient Service in an Academic Tertiary Care Referral Center	US	US; Pennsylvania		1675 patient records	Toxicology	toxicology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A		no
van der Meulen, M. Najafabadi, A. H. Z. Lobatto, D. J. van den Hout, W. B. Andela, C. D. Zandbergen, I. M. Pereira, A. M.	2020	Healthcare utilization and costs among prolactinoma patients: a cross-sectional study and analysis of determinants	The Netherlands	The Netherlands		373 patients	Endocrinology, Pituitary adenoma, prolactinoma	endocrinology		full care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	Paper only		no
Edholm, K. Lappe, K. Kukhareva, P. Hopkins, C. Hatton, N. D. Gebhart, B. Nyman, H.	2020	Reducing Diabetic Ketoacidosis Intensive Care Unit Admissions Through an Electronic Health Record-Driven, Standardized Care Pathway	US	US; Utah	single center, retrospective, pre and post intervention	214 hospital admissions	Acute care, emergency care	emergency care & acute care		full care path	Direct	provider	provider	unspecified; Hospital accounting data, value based outcomes toolk	Direct costing	implemented		no
Vanni, F. Foglia, E. Pennestri, F. Ferrario, L. Banfi, G.	2020	Introducing enhanced recovery after surgery in a high-volume orthopedic hospital: a health technology assessment	Italy	Italy	single center, retrospective, mixed methods observational study	938 procedures	orthopedics, total knee arthroplasty, total hip arthroplasty	Surgical	Orthopedic, arthroplasty	full care path (full surgical episode)	Direct and indirect	provider	provider	ABC	Absorption costing - ABC	implemented		yes see second sheet
Click, B. Lopez, R. Arrigain, S. Schold, J. Regueiro, M. Rizk, M.	2020	Shifting Cost-drivers of Health Care Expenditures in Inflammatory Bowel Disease	US	US; various states		641 patients	IBS, bowel, crohn's, Inflamatory Bowel Disease, ulcerative colitis	Internal Medicine		full care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Padilla, J. A. Gabor, J. A. Ryan, S. P. Long, W. J. Seyler, T. M. Schwarzkopf, R. M.	2020	Total Hip Arthroplasty for Femoral Neck Fracture: The Economic Implications of Orthopedic Subspecialty Training	US	US; various states		291 patients	orthopedics, total hip athroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursement as ratio of bundle price	no

Kaplan, A. L. Agarwal, N. Setlur, N. P. Tan, H. J. Niedzwiecki, D. McLaughlin, N. Burke, M. A.	2015	Measuring the cost of care in benign prostatic hyperplasia using time driven activity-based costing (TDABC)	US	US; California	single center, retrospective, direct observation	one care pathway, 5 surgical options	Urology, benign prostatic hyperplasia	Urology		partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		unspecified		yes see second sheet
Pang, J. Crawford, K. Faraji, F. Ramsey, C. Kemp, A. Califano, J. A.	2020	An Analysis of 1-Year Charges for Head and Neck Cancer: Targets for Value-Based Interventions	US	US; various states		196 consecutive patients	Oncology, head and neck cancer	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based		N/A	charges	no
Lobatto, D. J. Vlieland, Tpmv van den Hout, W. B. de Vries, F. de Vries, A. F. Schutte, P. J. Mantenaar, M. J. T.	2020	Feasibility, safety, and outcomes of a stratified fast-track care trajectory in pituitary surgery	The Netherlands	The Netherlands	prospective, observational study, process mapping	155 patients	Endocrinology, surgical, pituitary	endocrinology		partial care path (full surgical episode)	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic		Paper only		no
Patel, M. I. Ramirez, D. Agajanian, R. Agajanian, H. Coker, T.	2020	Association of a Lay Health Worker Intervention With Symptom Burden, Survival, Health Care Use, and Total Costs Among Medicare Enrollees With Cancer	US	US; various states		425 patients	Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based		N/A	charges	no
Jalilian, H. Doshmangir, L. Ajami, S. Mir, H. Siraneh, Y. Hasanpoor, E.	2019	Economic burden of gastric cancer in the first six months after diagnosis	Iran	Iran		118 patients	Oncology, bowel, gastric cancer	Oncology		unspecified	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic		Paper only		no
Lobatto, D. J. van den Hout, W. B. Najafabadi, A. H. Z. Steffens, A. N. V. Andela, C. D. Pereira, A. M. Peul, W. C.	2019	Healthcare utilization and costs among patients with non-functioning pituitary adenomas	The Netherlands	The Netherlands		167 patients	Endocrinology, Pituitary adenoma	endocrinology		partial care path	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic		N/A		no
Gray, C. F. Prieto, H. A. Deen, J. T. Parvataneni, H. K.	2019	Bundled Payment "Creep": Institutional Redesign for Primary Arthroplasty Positively Affects Revision Arthroplasty	US	US; Florida		168 patients	orthopedics, total joint arthroplasty	Surgical	Orthopedic, arthroplasty	full care path (surgical episode)	Direct and indirect	payer, provider	payer	provider	none; charges	Charges/Reimbursement-based	Direct costing	N/A		no
Kurt, P. Saban, M. Cankaya, F. Annac, M. C.	2019	Time-Driven Activity-Based Costing in the Ophthalmology Department of State Hospital: A Case Study	Turkey	Turkey	single center, retrospective, case study	case study; 5 surgical procedures in one department	Opthalmology	opthalmology		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
Thaci, B. McGirt, M. J. Ammerman, J. M. Thome, C. Kim, K. D. Ament, J. D.	2019	Reduction of direct costs in high-risk lumbar discectomy patients during the 90-day post-operative period through annular closure	US	US; California	randomized controlled trial,	272 patients	Surgical, high-risk lumbar discectomy	Surgical	Spine	partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based		N/A		no
Karns, M. R. Jones, D. L. Todd, D. C. Maak, T. G. Aoki, S. K. Burks, R. T. Yoo, M.	2018	Patient- and Procedure-Specific Variables Driving Total Direct Costs of Outpatient Anterior Cruciate Ligament Reconstruction	US	US; Utah	Retrospective cohort, single center, economic and decision analysis	434 patients	orthopedic, surgical, Anterior Cruciate Ligament Reconstruction, sports medicine	Surgical	Orthopedic	partial care path (full surgical episode)	Direct	provider	provider	VDO tool, total direct costs	Direct costing		implemented		yes see second sheet
Robinson, J. R. Carter, N. H. Gibson, C. Brinkman, A. S. Van Arendonk, K. Speck, K. E. Danko, M. E.	2018	Improving the value of care for appendectomy through an individual surgeon-specific approach	US	US; tennessee	prospective observational study	216 patients	Appendicitis, surgical	Surgical	Appendicitis	partial care path (full surgical episode)	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic		N/A		yes see second sheet
Gupta, P. Rettiganti, M.	2017	Relationship of Hospital Costs With Mortality in Pediatric Critical Care: A Multi-Institutional Analysis	US	US; various states	single center, pre and post intervention **(dashboard)**	917,663 patients, 47 hospitals	Acute care, pediatrics	pediatrics	Pediatric acute care	partial care path	unspecified	payer	payer	unspecified	Charges/Reimbursement-based		N/A	charges	no
Ilg, A. M. Laviana, A. A. Kamrava, M. Veruttipong, D. Steinberg, M. Park, S. J. Burke, M. A.	2016	Time-driven activity-based costing of low-dose-rate and high-dose-rate brachytherapy for low-risk prostate cancer	US	US; California	single center, retrospective, process mapping, direct observation	2 treatment options	Oncology, prostate cancer, brachytherapy	Oncology		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
McLaughlin, N. Burke, M. A. Setlur, N. P. Niedzwiecki, D. R. Kaplan, A. L. Saigal, C. Mahajan, A.	2014	Time-driven activity-based costing: a driver for provider engagement in costing activities and redesign initiatives	US	US; California	single center, process mapping	2 pilots	Urology, neurosurgery	Surgical	Neurosurgery	partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		implemented		no

Keating, C. L. Dixon, J. B. Moodie, M. L. Peeters, A. Playfair, J. O'Brien, P. E.	2009	Cost-Efficacy of Surgically Induced Weight Loss for the Management of Type 2 Diabetes A randomized controlled trial	Australia	Australia	randomized controlled trial,	40 patients, 23 surgical, 7 medical	Surgical, Diabetes	Internal Medicine	unspecified	Direct	provider	provider	direct costs	Direct costing	Paper only		no
Nelson, A. A. Pearce, D. J. Fleischer, A. B. Balkrishnan, R. Feldman, S. R.	2005	Infliximab for inpatient psoriasis management - is there a role?	US	US; Ohio		208 inpatient admissions	Psoriasis, Dermatology	Dermatology	partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Yanik, John M. Bedard, Nicholas A. Hanley, Jessica M. Otero, Jesse E. Callaghan, John J. Marsh, John L.	2018	Rapid Recovery Total Joint Arthroplasty is Safe, Efficient, and Cost-Effective in the Veterans Administration Setting	US	US; Iowa		78 patients	orthopedics, total hip athroplasty, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	unspecified		no
Zhang, Steven Vora, Molly Harris, Alex H. S. Baker, Laurence Curtin, Catherine Kamal, Robin N.	2016	Cost-Minimization Analysis of Open and Endoscopic Carpal Tunnel Release	US	US; California		16 million patient records	Carpal Tunnel Release	Surgical	Carpal Tunnel Release	full care path (surgical episode)	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
A. Adenikinju, R. Ranson, S. A. Rettig, K. A. Egol and S. R. Konda	2021	Ability of a Risk Prediction Tool to Stratify Quality and Cost for Older Patients With Operative Distal Radius Fractures	US	US; New York			Orthorpedic, Geriatric, Operative Distal Radius Fractures	Surgical	Orthopedic fracture	unspecified	Direct and indirect	payer	payer	unspecified; Hospital accounting data not otherwise specified	Charges/Reimbursement-based	N/A	index admission cost, per category	no
A. Alibrahim, Y. Abdulsalam, S. Al Mutawa, H. Behbehani, D. Alhuwail and S. Al Jenaei	2021	Towards value-based healthcare: Establishing baseline pharmacy care costs for diabetes management	Kuwait	Kuwait	single center, observation, interviews	one pharmacy	Diabetes, pharmacy	Internal Medicine		partial care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		yes see second sheet
D. J. Baughman, A. Waheed, M. N. Khan and J. M. Nicholson	2021	Enhancing Value-Based Care With a Walk-in Clinic: A Primary Care Provider Intervention to Decrease Low Acuity Emergency Department Overutilization	US	US; Pennsylvania			Emergency care	emergency care & acute care		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	average charges	no
J. A. Berinstein, S. A. Cohen-Mekelburg, G. M. Greenberg, D. Wray, S. K. Berry, S. D. Saini, A. M. Fendrick, M. A. Adams, A. K. Waljee and R. D. R. Higgins	2021	A Care Coordination Intervention Improves Symptoms But Not Charges in High-Risk Patients With Inflammatory Bowel Disease	US	US; Michigan			IBS/IBD inflammatory bowel disease	Internal Medicine		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
A. Beschloss, C. Dicindio, J. Lombardi, A. Varthi, A. Ozturk, R. Lehman, L. Lenke and C. Saifi	2021	Marked Increase in Spinal Deformity Surgery Throughout the United States	US	US; various states			Orthopedic, Spinal Deformity Surgery	Surgical	Spine	full care path	Direct and indirect	provider	provider	none; charges	Charges/Reimbursement-based	N/A	unspecified	no
H. Bueno, J. L. Bernal, V. Jimenez-Jimenez, F. J. Martin-Sanchez, X. Rossello, G. Moreno, C. Goni, V. Gil, P. Llorens, N. Naranjo, J. Jacob, R. Herrero	2021	The Clinical outcomes, healthcare resource utilization, and related costs (COHERENT) model. Application in heart failure patients	Spain	Spain	Retrospective, multi-center	30 day period of heart failure patients	heart failiure, cardiovascular	Cardiology		partial care path	Direct and indirect	provider	provider	DRG costs	Absorption costing - unspecified/generic	implemented		yes see second sheet
R. A. Burnett Iii, J. Yang, P. M. Courtney, E. B. Terhune, C. P. Hannon and C. J. Della Valle	2021	Costs of unicompartmental compared with total knee arthroplasty : a matched cohort study over ten years	US	US; various states			Total knee arthroplasty, orthopedic	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	provider	provider	none; reimbursements	Charges/Reimbursement-based	N/A	reimbursement	no
M. Casey, D. Perera, J. Enticott, H. Vo, S. Cubra, A. Gravell, M. Waerea and G. Habib	2021	High utilisers of emergency departments: the profile and journey of patients with mental health issues	Australia	Australia			Emergency care	emergency care & acute care		partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	N/A		yes see second sheet
K. A. Chovanec, C. Arsene, A. Beck and B. Liedel	2022	Why Not Home?: A Study of the Impact of an Effort to Reduce Postacute Expenditures	US	US; various states			Various, post-acute	emergency care & acute care		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
R. V. Cohen, A. M. Nishikawa, R. A. Ribeiro, F. M. Oliveira, P. C. Andrade, S. M. Junqueira and B. Toldo	2021	Surgical Management of Obesity in Brazil: Proposal for a Value-Based Healthcare Model and Preliminary Results	Brazil	Brazil			Obesity, surgical, bariatric surgery	Surgical	Bariatric	full care path	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic	N/A		yes see second sheet

A. P. B. da Silva Etges, L. N. Cruz, R. Schlatter, J. Neyeloff, R. B. Cardoso, L. Kopittke, A. A. Nunes, J. A. Neto, J. L. Nogueira, R. M. de Assis, L. S. P. Tobias, I.	2022	Time-driven activity-based costing as a strategy to increase efficiency: An analyses of interventional coronary procedures	Brazil	Brazil	multi center, retrospective, process mapping, 5 hospitals	5 hospitals, 90 patients	Interventional Coronary Procedures	Cardiology		full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		unspecified		yes see second sheet
M. Dziemianowicz, J. Burmeister and M. Dominello	2021	Examining the Financial Impact of Altered Fractionation in Breast Cancer: An Analysis Using Time-Driven Activity-Based Costing	US	US; Michigan	single center, retrospective, process mapping, direct observation, treatment comparison	2 treatment options, 50 patient visits total	Oncology, breast cancer, cancer, sentinel lymph node biobsy, Altered Fractionation in Breast Cancer	Oncology		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
C. Fang, A. Hagar, M. Gordon, C. T. Talmo, D. A. Mattingly and E. L. Smith	2021	Differences in Hospital Costs among Octogenarians and Nonagenarians Following Primary Total Joint Arthroplasty	US	US; Boston	single center, retrospective, patient comparison	889 surgeries	Geriatrics, Orthopedic, Primary Total Joint Arthroplasty	Surgical	Orthopedic fracture	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		unspecified		yes see second sheet
C. Fang, N. Pagani, M. Gordon, C. T. Talmo, D. A. Mattingly and E. L. Smith	2021	Episode-of-Care Costs for Revision Total Joint Arthroplasties by Decadal Age Groups	US	US; Boston	single center, retrospective, patient comparison	551 surgeries	Geriatrics, Orthopedic, Primary Total Joint Arthroplasty	Surgical	Orthopedic fracture	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		unspecified		yes see second sheet
C. J. Fang, J. M. Shaker, J. M. Drew, A. Jawa, D. A. Mattingly and E. L. Smith	2021	The Cost of Hip and Knee Revision Arthroplasty by Diagnosis-Related Groups: Comparing Time-Driven Activity-Based Costing and Traditional Accounting	US	US; Boston	single center, retrospective, process mapping	793 surgeries	Geriatrics, Orthopedic, Primary Total Joint Arthroplasty	Surgical	Orthopedic arthroplasty	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Absorption costing - unspecified/generic	Paper only		yes see second sheet
C. J. Fang, J. M. Shaker, P. A. Hart, C. Cassidy, D. A. Mattingly, A. Jawa and E. L. Smith	2021	Variation in the Profit Margin for Different Types of Total Joint Arthroplasty	US	US; Boston	single center, retrospective	13545 procedures	Geriatrics, Orthopedic, Primary Total Joint Arthroplasty	Surgical	Orthopedic arthroplasty	full care path (surgical episode)	Direct and indirect	provider, payer	provider	payer	TDABC	Absorption costing - TDABC	Charges/Reimbursement-based	unspecified		yes see second sheet
C. A. Feizpour, M. S. Patel, M. A. Syed, A. Carrasco, J. Shah, S. Hanish, L. Sosa, S. Fogus, S. Bennett, C. Shi, B. Hardman and P. A. Vezeb	2021	Enhanced recovery in liver transplantation: A value-based approach to complex surgical care	US	US; Texas	Retrospective, single center, pre and post intervention	379 liver transplant recipients	Surgical, enhanced recovery pathway, liver transplant	Surgical	Liver	full care path	Direct	provider	provider		direct costs	Direct costing		unspecified	unspecified	no
A. M. Fontebasso, S. Figueira, K. Thavorn, P. Glen, J. Lampron and M. Matar	2020	Financial implications of trauma patients at a Canadian level 1 trauma center: a retrospective cohort study	Canada	Canada			Surgical, Trauma surgery	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	provider	provider		unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic		N/A		no
M. Gandjian, C. Williamson, Y. Sanaiha, J. Hadaya, Z. Tran, S. T. Kim, S. Revels and P. Benharash	2021	Continued Relevance of Minimum Volume Standards for Elective Esophagectomy: A National Perspective	US	US; various			elective esophagectomy, cardiovascular	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	provider (proxy)	payer		none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy		N/A	charges, transformed with cost-to-charge ratio	no
I. M. Ganske, K. Sanchez, E. Le, O. C. Langa, B. Sharif-Askary, E. Ross, P. Santiago, J. G. Meara, B. L. Padwa and A. C. Allori	2021	Time-Driven, Activity-Based Costing of Presurgical Infant Orthopedics: A Critical Component of Establishing Value of Latham Appliance and Nasoalveolar Molding	US	US; Boston	multi center, prospective, process mapping, direct observation	37 patients, two hospitals	pediatric, crainiofacial, presurgical infant orthopedics, plastic surgery, reconstructive surgery, Latham device	Pediatrics	Pediatric Plastic surgery	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
H. C. Gillis, K. Dolan, C. L. Sargel, R. Z. Thompson and J. E. Lutmer	2021	A Quality Improvement Approach to Influence Value-based Mucolytic Use in the PICU	US	US; Ohio			pediatric, pediatric intensive care, PICU, Mucolutic aerosols	Pediatrics	Pediatric acute care	partial care path	Direct	provider	provider		direct costs (medicine costs)	Direct costing		N/A		no
J. Hadaya, Y. Sanaiha, R. Hernandez, Z. Tran, R. J. Shemin and P. Benharash	2021	Impact of hospital volume on resource use after elective cardiac surgery: A contemporary analysis	US	US; various			elective cardiac surgery	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	provider (proxy)	payer		none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy		N/A	charges, transformed with cost-to-charge ratio	no
M. K. Islam, S. Ruths, K. Jansen, R. Falck, M. R. Molken and J. E. Askildsen	2021	Evaluating an integrated care pathway for frail elderly patients in Norway using multi-criteria decision analysis	Norway	Norway			geriatrics, frail elderly, multi-morbidity	Geriatrics		unspecified	Direct and indirect	provider, patient	provider	patient	reference pricing	Absorption costing - unspecified/generic	Charges/Reimbursement-based patient OoO	N/A		no
D. W. Jang, H. J. Lee, P. G. Chen, S. M. Cohen and C. D. Scales	2021	Geographic Variations in Healthcare Utilization and Expenditure for Chronic Rhinosinusitis: A Population-Based Approach	US	US; various			surgical, head and neck, Chronic rhinosinusitis	Surgical	ENT	full care path	Direct and indirect	payer	payer		none; charges	Charges/Reimbursement-based		N/A	charges	no

H. Ko, D. S. Brodke, M. E. Vanneman, A. J. Schoenfeld and B. I. Martin	2021	Is Discretionary Care Associated with Safety Among Medicare Beneficiaries Undergoing Spine Surgery?	US	US; various			spine surgery, surgical	Surgical	Spine	partial care path	Direct and indirect	payer	payer	none; reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
S. R. Konda, J. R. Johnson, N. Dedhia, E. A. Kelly and K. A. Egol	2021	Can We Stratify Quality and Cost for Older Patients With Proximal and Midshaft Humerus Fractures?	US	US; various			Humerus Fractures, geriatrics, orthopedic	Surgical	Orthopedic fracture	unspecified	Direct	provider	provider	direct variable costs as an estimation of total costs	Direct costing	N/A		no
A. T. Malik, S. N. Khan, R. T. Voskuil, J. H. Alexander, J. P. Drain and T. J. Scharschmidt	2021	What Is the Value of Undergoing Surgery for Spinal Metastases at Dedicated Cancer Centers?	US	US; various			Orthopedic, Surgical, spine surgery	Oncology		partial care path	Direct and indirect	payer	payer	none; reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
T. R. McClintock, D. F. Friedlander, A. Y. Feng, M. A. Shah, D. J. Pallin, S. L. Chang, A. M. Bader, T. W. Feeley, R. S. Kaplan and G. E. Hutchins	2021	Determining Variable Costs in the Acute Urolithiasis Cycle of Care Through Time-Driven Activity-Based Costing	US	US; Boston	multi center, retrospective, process mapping, journey mapping	unspecified number of patients, acute stone episodes	Acute Urolithiasis	emergency care & acute care		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		yes see second sheet
R. Negrini, R. D. da Silva Ferreira and D. Z. Guimaraes	2021	Value-based care in obstetrics: comparison between vaginal birth and caesarean section	Brazil	Brazil	single center, retrospective, process mapping	9345 deliveries	Obstetrics, birth, vaginal birth, caesarean birth	gynecology & obstetrics		full care path	Direct and indirect	provider	provider	direct and indirect costs	Absorption costing - unspecified/generic	Paper only		yes see second sheet
T. V. Newman, K. D. Munshi, L. M. Neilson, C. B. Good, E. C. S. Swart, Y. Huang, R. Henderson and N. Parekh	2021	Health care utilization and costs associated with switching from DPP-4i to GLP-1RA or SGLT2i: an observational cohort study	US	US; various			Diabetes	Internal Medicine		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
N. Panda, L. Shagabayeva, C. E. Comrie, N. Phan, P. Moonsamy, C. F. Jeffrey Yang, F. G. Fernandez and C. R. Mayo	2022	Drivers of Cost Associated With Minimally Invasive Esophagectomy	US	US; Boston			esophagectomy, surgical, thoracic surgery	Surgical	Cardiac/Thoracic	full care path	Direct	provider	provider	direct costs	Direct costing	N/A		no
S. K. Pasquali, D. Thibault, M. Hall, K. Chiswell, J. C. Romano, J. W. Gaynor, D. M. Shahian, M. L. Jacobs, M. G. Gaies, S. M. O'Brien, E. C. Norton	2021	Evolving Cost-Quality Relationship in Pediatric Heart Surgery	US	US; Boston	Retrospective, multi-center	45315 patients, 32 hospitals	pediatrics, surgical, pediatric heart surgery	Pediatrics	Pediatric surgical	full care path	direct and indirect	provider	provider	CHD-method standardized costs	Absorption costing - unspecified/generic	Paper only		no
R. K. Sethi, R. P. Pumpian, C. E. Drolet and P. K. Louie	2021	Utilizing Lean Methodology and Time-Driven Activity-Based Costing Together: An Observational Pilot Study of Hip Replacement Surgery Utilizing a New Method to Study Value-Based Health Care	US	US; Washington	single center, retrospective, surgeon comparison	346 patients	surgical, orthopedic, hip replacement surgery, anterior hip arthroplasty	Surgical	Orthopedic, arthroplasty	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
N. G. Thaker, D. Boyce-Fappiano, M. S. Ning, D. Pasalic, A. Guzman, G. Smith, E. B. Holliday, J. Incalcaterra, A. S. Garden, S. E.	2021	Activity-Based Costing of Intensity-Modulated Proton versus Photon Therapy for Oropharyngeal Cancer	US	US; Texas	single center, process mapping, matched sample	50 patients (matched pairs)	oncology, radiation oncology	Oncology		partial care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	implemented		yes see second sheet
S. Tomicki, G. Dieguez, H. Latimer, P. Cockrum and G. Kim	2021	Real-World Cost of Care for Commercially Insured versus Medicare Patients with Metastatic Pancreatic Cancer Who Received Guideline-Recommended Therapies	US	US; various			oncology, metastatic pancreatic cancer	Oncology		full care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
W. Wang, E. Li, K. Campbell, A. McBride and S. D'Amato	2021	Economic Analysis on Adoption of Biosimilar Granulocyte Colony-Stimulating Factors in Patients With Nonmyeloid Cancer at Risk of Febrile Neutropenia Within the Oncology Care Model Framework	US	US; New Jersey			oncology, Nonmyeloid Cancer	Oncology		partial care path	Direct	provider	provider	direct costs	Direct costing	N/A		no
K. L. Wise, H. R. Parikh, B. Okelana, A. J. Only, M. Reams, A. Harrison, J. Braman, E. Craig and B. P. Cunningham	2022	Measurement of value in rotator cuff repair: patient-level value analysis for the 1-year episode of care	US	US; Minnesota	single center, retrospective, process mapping	396 patients	orthopedic, surgical, rotator cuff repair	Surgical	Orthopedic rotator cuff repair	full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		yes see second sheet
C. Iloabuchi, N. Dwibedi, T. LeMasters, C. Shen, A. Ladani and U. Sambamoorthi	2021	Low-value care and excess out-of-pocket expenditure among older adults with incident cancer – A machine learning approach	US	US; various			oncology, incident cancer	Oncology		full care path	Direct	patient	patient	total out of pocket expenditures (SEER data)	Charges/Reimbursement-based patient OoO	N/A		no

N. Seyidova, A. D. Chen, D. del Valle, D. Chi, R. P. Cauley, B. T. Lee and S. J. Lin	2021	Nationwide cost variation for lower extremity flap reconstruction	US	US; various			lower extremity flap reconstruction, surgical, plastic surgery	Surgical	Plastic surgery	full care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
A. Jacir, D. Mendoza, E. Dean and H. Gitlow	2021	The cost of care during times of COVID: Case study of TDABC and minimum utilization cost analysis in a medicare advantage population	US	US; Florida	single center, process mapping, case study	case study, telehealth visits	Covid	Infectious disease		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		no
D. Fürstenau, H. Haneke, C. Spies, T. Walz, K. Schewina, M. Höft, R. Mörgeli and F. Balzer	2021	Tackling the frailty burden with an integrative value-based approach: results from a mixed-methods study	Germany	Germany			surgical, perioperative process	Surgical	other	partial care path	unspecified	provider	provider	bottom-up clinical costing approach	Unspecified	N/A		no
J. F. Buell, A. N. Flaris, S. Raju, A. Hauch, M. Darden and G. G. Parker	2021	Long-Term Outcomes in Complex Abdominal Wall Reconstruction Repaired with Absorbable Biologic Polymer Scaffold (Poly-4-Hydroxybutyrate)	US	US; North Carolina			Surgical, abdominal wall reconstruction, rehernia tion, complex abdominal wall hernia	Surgical	Abdominal	partial care path	Direct	payer	payer	none; charges	Charges/Reimbursement-based	N/A		no
V. J. Siu, T. Varkey, U. N. Khan, J. B. Ding and S. Gandhi	2021	Lend Me a Hand: A Value-Based Care Case Study on Pan Plexopathy of Unknown Origin	US	US; Texas			pan plexopathy, neurology, brachial plexus injury	Neurology		unspecified	Direct	patient	patient	out of pocket costs to patient	Charges/Reimbursement-based patient OoO	N/A		no
J. B. Kukreja, M. A. Seif, M. W. Mery, J. R. Incalcaterra, A. M. Kamat, C. P. Dinney, J. B. Shah, T. W. Feeley and N. Navai	2021	Utilizing time-driven activity-based costing to determine open radical cystectomy and ileal conduit surgical episode cost drivers	US	US; Texas	single center, retrospective, process mapping	100 patients	open radical cystectomy, urology, oncology, bladder cancer	Oncology		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
King, B. C. Richardson, T. Patel, R. M. Lee, H. C. Bamat, N. A. Hall, M. Slaughter, J. L.	2021	Prioritization framework for improving the value of care for very low birth weight and very preterm infants	US	US; Texas	Retrospective cohort, multi center	26098 preterm or low birth weight infants	Preterm infants, neonatal, perinatology, pediatrics	Pediatrics	Pediatric Neonatal	partial care path	Direct and indirect	payer	payer	charges standardized across hospitals	Charges/Reimbursement-based	N/A	charges	no
L. Fernando-Canavan, A. Gust, A. Hsueh, A. Tran-Duy, M. Kirk, P. Brooks and J. Knight	2021	Measuring the economic impact of hospital-acquired complications on an acute health service	Australia	Australia	single center, retrospective, mixed methods observational study	93 056 cases	emergency care, hospital acquired complications	emergency care & acute care		partial care path	Direct and indirect	provider	provider	bottom-up clinical costing approach	Absorption costing - unspecified/generic	unspecified		yes see second sheet
H. Skibicki, M. Yayac, C. A. Krueger and P. M. Courtney	2021	Target Price Adjustment for Hip Fractures Is Not Sufficient in the Bundled Payments for Care Improvement Initiative	US	US; Pennsylvania			arthroplasty, hip fractures, orthopedics	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges (EOC costs)	no
D. Clewley, Y. Iftikhar, M. E. Horn and D. I. Rhon	2020	Do the Number of Visits and the Cost of Musculoskeletal Care Improve Outcomes? More May Not Be Better	US	US; Texas	Retrospective, clinical trial	98 patients	Subacromial pain syndrome	Pain medicine		partial care path	Direct and indirect	payer	payer	none; reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
B. Walker, L. Wilfong, J. Frytak and N. Robert	2021	Practice patterns among oncologists participating in the oncology care model after three years	US	US; Louisiana			oncology, cancer	Oncology		full care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
C. A. Krueger, M. Yayac, C. Vannello, J. Wilsman, M. S. Austin and P. M. Courtney	2021	Are We at the Bottom? BPCI Programs Now Disincentivize Providers Who Maintain Quality Despite Caring for Increasingly Complex Patients	US	US; Pennsylvania			orthopedic, total hip arthroplasty, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	payer	payer	none; reimbursement	Charges/Reimbursement-based	N/A	reimbursement	no
B. S. Horton, J. D. Marland, H. S. West and J. D. Wylie	2021	Transition to Telehealth Physical Therapy After Hip Arthroscopy for Femoroacetabular Impingement: A Pilot Study With Retrospective Matched-Cohort Analysis	US	US; Utah	Pilot		orthopedics, hip athroscopy, physical therapy	Orthopedic		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
N. H. Nguyen, J. Luo, L. Ohno-Machado, W. J. Sandborn and S. Singh	2021	Burden and Outcomes of Fragmentation of Care in Hospitalized Patients With Inflammatory Bowel Diseases: A Nationally Representative Cohort	US	US; California			Gastroenterology, Inflammatory Bowel Diseases	Internal Medicine		full care path	Direct and indirect	provider (proxy)	payer	none; charges HCUP data	Charges/Reimbursement-based	N/A	charges	no

Y. Sanaiha, P. Downey, R. Lyons, A. Nsair, R. J. Shemin and P. Benharash	2021	Trends in utilization, mortality, and resource use after implantation of left ventricular assist devices in the United States	US	US; various			cardiovascular, left ventricular assist devices	Surgical	Cardiac/Thoracic	full care path	Direct and indirect	provider (proxy)	payer	none; reimbursements, cost-charge-ratio, NIS data	Charges/Reimbursement-based proxy	N/A	charges transformed with cost-to-charge ratio	no
Khanijow, A. N. Wood, L. N. Xie, R. Theiss, L. M. Hollis, R. H. Hardiman, K. M. Connolly, D. J.	2021	The impact of an enhanced recovery program (ERP) on the costs of colorectal surgery	US	US; Alabama	single center, retrospective	616 surgical cases	surgical, colorectal surgery	Surgical	Colon/Rectal	partial care path (full surgical episode)	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	Paper only		yes see second sheet
Jacobs, K. Dewilde, T. Vandoren, C. Cardoen, B. Vansteenkiste, N. Scheys, L. Roodhooft, F.	2020	Variability in Hospital Costs of Adult Spinal Deformity Care	The Netherlands	The Netherlands	single center, retrospective	139 patients	Surgical, spine, Adult Spinal Deformity	Surgical	Spine	full care path	Direct	provider	provider	ABC (excluding overheads)	Absorption costing - ABC	Paper only		yes see second sheet
Mattar, D. Di Filippo, A. Invento, A. Radice, D. Burcuta, M. Bagnardi, V. Veronesi, G.	2021	Economic implications of ACOSOG Z0011 trial application into clinical practice at the European Institute of Oncology	Italy	Italy	single center, retrospective, clinical trial, compare pre and post	3912 patients	oncology, breast cancer, cancer, sentinel lymph node biobsy	Oncology		partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	implemented		yes see second sheet
Weir, T. B. Usmani, M. F. Camacho, J. Sokolow, M. Bruckner, J. Jazini, E. Iyengar, J. J.	2021	Effect of Surgical Setting on Cost and Hospital Reported Outcomes for Single-Level Anterior Cervical Discectomy and Fusion	US	US; Maryland	multi center, retrospective	301 patients	Spine, surgical, Anterior Cervical Discectomy and Fusion	Surgical	Spine	full care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	Paper only		no

Inclusions RQ2 (49) extracted data to be shared with Erasmus Data Repository (FigShare)

	Study characteristics						Costing method characteristics					Value-Based consequences of costing information (facilitators)			
year	Reference	Medical Specialty	Costing method	Costing period	Centre	Study type	PM: Process Mapping	EI: Expert Input	DO: Direct Observation	CG: Cost grouping, either per item or per activity, or both	Benchmarking across/Compare costs across	Identification of Cost Drivers	Measured cost difference	Care path adjustment(s)
2022	(Alibrahim et al., 2022)	Internal medicine	TDABC	partial	single	retro	yes	yes		items, activities		yes		suggested
2022	(Wise et al., 2022)	Surgical, orthopaedic, rotator cuff re	TDABC	full (FSE)	single	retro	yes		yes	items, activities	surgeons, two alternative treatments within one care path	yes	yes, ± $727 about the mean per patient	suggested
2021	(Etges et al., 2021)	Cardiology (incl. several surgeries)	TDABC	full (FSE)	multi	retro	yes	yes	yes	items, activities	hospitals, interventional coronary procedures	yes	yes, estimate 51.0% of procedure cost	yes
2021	(Dziemianowicz et al., 2021)	Oncology	TDABC	full	single	retro	yes	yes	yes	items, activities	treatment care paths (accelerated whole breast irradiation vs. usual care)	yes	$2,302 (25.0%) difference across treatments	suggested
2021	(Fang, Hagar, Gordon, et al., 2021)	Surgical, orthopaedic fracture	TDABC	full (FSE)	single	retro	yes			items, activities	patients	yes		suggested
2021	(Fang, Shaker, Drew, et al., 2021)	Surgical, orthopaedic, arthroplasty	TDABC	full (FSE)	single	retro	yes		yes	items, activities	costing methods (TA and TDABC)	yes		suggested
2021	(Fang, Shaker, Hart, et al., 2021)	Surgical, orthopaedic, arthroplasty	TDABC	full (FSE)	single	retro	yes		yes	items, activities	five treatments (total joint arthroplasties), cost vs. reimbursement	yes		
2021	(Ganske et al., 2021)	Paediatric, surgical, plastic surgery	TDABC	full (FSE)	multi	Pro	yes		yes	items, activities	treatment care paths	yes	up to $8900 if surgery was required, but long-term outcomes yet	suggested
2021	(McClintock et al., 2021)	Emergency & acute care	TDABC	full (multiple)	multi	retro	yes	yes	yes	items, activities	eight care paths for acute ureteral stones (patient journeys)	yes	yes, $6614 difference across care paths	suggested
2021	(Sethi, Pumpian, Drolet, & Louie, 2021)	Surgical, orthopaedic arthroplasty	TDABC	full (FSE)	single	retro	yes		yes	items, activities	surgeons	yes		suggested
2021	(Thaker et al., 2021)	Oncology	TDABC	partial	single	pro	yes	yes	yes	items, activities	treatments (matched sample, intensity-modulated proton vs. photon therapy) and individual care paths	yes	yes, cost difference of up to 3.33 times, depending on patient	suggested
2021	(Kukreja et al., 2021)	Oncology (incl. surgery)	TDABC	full	single	retro	yes		yes	items, activities		yes		suggested
2021	(Mattar et al., 2021)	Oncology	TDABC	partial (FSE)	single	retro	yes			items	pre and post implementation of Z0011 guidelines in oncology	yes	yes, mean cost savings of €309 per patient	yes
2021	(Bueno et al., 2021)	Cardiology	AC (other)	partial	multi	retro				items	patient journeys	yes		suggested
2021	(Casey et al., 2021)	Emergency & acute care	AC (other)	partial	single	retro	yes			items	surgeons	yes		
2021	(Cohen et al., 2021)	Surgical, bariatric	AC (other)	full (FSE)	single	retro				items	treatment	yes		
2021	(Negrini, da Silva Ferreira, & Guimaraes	Gynaecology & obstetrics	AC (other)	full	single	retro	yes			items, activities	procedures	yes	yes, $967 per patient	suggested
2021	(Fernando-Canavan et al., 2021)	Emergency & acute care	AC (other)	partial	single	retro				items, activities		yes		
2021	(Khanijow et al., 2021)	Surgical, colorectal	AC (other)	partial (FSE)	single	retro				items	intervention	yes	yes, reduced variable cost, similar total cost	yes
2020	(Wise et al., 2020)	Surgical, orthopaedics, fracture	ABC	partial (FSE)	single	retro				items	patients, patient groups, demographics	yes		
2020	(Vanni, Foglia, Pennestri, Ferrario, & Ba	Surgical, orthopaedic, arthroplasty	ABC	full (FSE)	single	both		yes	yes	items, activities	treatment care paths (enhanced recovery after surgery)	yes	estimate €2,054,000 annually	yes
2020	(Jacobs et al., 2020)	Surgical, spine	ABC	l, 1 year (incl. surgeri	single	retro	yes			items, activities	patients, patient groups	yes		suggested
2020	(Bodar et al., 2020)	Paediatric, surgical	TDABC	full (FSE)	single	both	yes		yes	items, activities	costing methods (TA and TDABC)	yes	20.0% and without care path alteration	suggested
2020	(Ning et al., 2020)	Oncology	TDABC	full (FSE)	single	retro	yes	yes	yes	items, activities	treatment care paths (MRI-guided vs. usual care)	yes	yes, estimate for each 10.0% decrease in case duration from baseline	suggested
2020	(Ahluwalia et al., 2020)	Surgical, orthopaedics fracture	TDABC	full (FSE)	single	pro	yes	yes	yes	items, activities	treatment care paths (home care vs. usual care), costs vs. reimbursements	yes	£2,018 per patient	suggested
2020	(Caloway et al., 2020)	Paediatric, neonatal	TDABC	partial	single	retro	yes	yes	yes	items, activities	before and after intervention (family-centred care coordination program)	yes	yes, 36.0% or $92,000 per tracheostomy care cycle	yes
2020	(Burnhope et al., 2020)	Surgical, cardiac/thoracic	AC (other)	partial	multi	retro	yes			items	patients, implant devices	yes		suggested
2020	(Lenfant, Sawczyn, Kim, Aminsharifi, &	Oncology, surgical	AC (other)	partial	single	retro				items		yes	yes, multiple	
2019	(Hernandez, Kaplan, Witkowski, Faison,	Multiple	TDABC	full	multi, pilot	retro	yes	yes	yes	items, activities	before and after intervention (IPUs)	yes	yes, quarterly costs declined	suggested
2019	(Basto, Chahal, & Riedel, 2019)	Oncology	TDABC	partial (PSE)	single	pro	yes		yes	items, activities	treatment care paths (parallel vs. induction design in OR)	yes	yes, estimate OR time reduction of 55 min, or $,2818 missed revenue	suggested
2019	(McCreary et al., 2019)	Surgical, orthopaedics fracture	TDABC	partial (FSE)	single	both	yes			items		yes		suggested
2019	(Ahluwalia et al., 2019)	Surgical, foot debridement	TDABC	partial (FSE)	single	retro			yes	items	before and after intervention (traffic-light principle)	yes		yes
2019	(Kurt, Saban, Cankaya, & Annac, 2019)	Ophthalmology	TDABC	ull (entire department	single	retro	yes	yes	yes	items, activities		yes		suggested
2019	(Danilyants, MacKoul, van der Does, Hav	Gynaecology & obstetrics (incl. surgery)	AC (other)	partial (FSE)	single	retro				items		yes		suggested
2019	(Danilyants, MacKoul, Baxi, van der Doe	Gynaecology & obstetrics (incl. surg	AC (other)	partial (FSE)	single	retro				items		yes		
2019	(Chatfield et al., 2019)	Multiple	Direct costing	partial	single	retro				items		yes		
2019	(Featherall et al., 2019)	Surgical, orthopaedic arthroplasty	Direct costing	full (FSE)	multi	retro				items	intervention		yes, £255 per patient	yes
2018	(Martin et al., 2018)	Surgical, carpal tunnel release	TDABC	partial (FSE)	multi	retro	yes		yes	items, activities	multiple treatment care paths (colonoscopy, aortic valve replacement, Carpal Tunnel Release)	yes	yes, 70.9% ($27,103) and 31.6% ($178)	yes
2018	(Robinson et al., 2018)	Surgical, appendicitis	AC (other)	partial (FSE)	single	pro		yes	yes	items	pre and post intervention (dashboard)	yes	yes, decreased by $496 per operation	yes
2018	(Karns et al., 2018)	Surgical, orthopaedic	Direct costing	partial (FSE)	single	retro		yes		items	intervention	yes		
2017	(Isaacson et al., 2017)	Urology	TDABC	partial	single	Pro	yes		yes	items, activities		yes	yes, estimate two hours per cycle	suggested
2017	(Yu et al., 2017)	Paediatrics, appendicitis	TDABC	full (FSE)	single	pro	yes	yes	yes	items, activities	treatment care paths (pre and post intervention)	yes	11.0% cost reduction, and 51.0% hospitalization time	yes, several
2017	(Parra et al., 2017)	Urology	AC (other)	partial	multi	retro		yes		items				
2016	(French et al., 2016)	Oncology, surgical	TDABC	tial (FSEs, 11 surgeri	single	retro	yes			items, activities	potential staffing ratios	yes	estimate 13.0-28.0% per surgery type	odelled and suggested
2016	(Ilg et al., 2016)	Oncology	TDABC	full	single	retro	yes	yes	yes	items, activities	treatments (high-dose vs. low-dose brachytherapy)	yes	$2,668 difference across treatments	yes
2015	(Kaplan et al., 2015)	Urology	TDABC	partial (FSE)	single	retro	yes	yes		items, activities	five treatment care paths	yes	yes, 400.0% increase from least to most exensive nathwavs	suggested
2014	(McLaughlin, Upadhyaya, et al., 2014)	Surgical, neurosurgery	ABC	partial (FSE)	single	retro	yes			items, activities	patients	yes	yes, 25.0%	yes, several
2014	(McLaughlin, Martin, et al., 2014)	Surgical, neurosurgery	ABC	partial (FSE)	single	retro	yes			items, activities	patients	yes		suggested
2011	(Abbott & Meara, 2011)	Paediatric plastic surgery	ABC	al, 1 year (incl. surge	single	retro				items	patients	yes		suggested
						Count	*34*	*16*	*24*		*39*	*47*	*26*	*40*

SUPPLEMENT DIGITAL CONTENT

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SUPPLEMENT DIGITAL CONTENT
2 Inclusion/exclusion criteria, data extracted

Eligibility criteria	
Language	English or Dutch
Publication date	Between 2003 and 1.1.2022
Research type	Original, peer-reviewed, empirical research
Terms	Any variation of the terms "cost" and "value-based" in title or abstract
Full text content	Costs of an intervention, treatment, care path, or other healthcare activity must have been measured or estimated.
Variables collected	
Descriptive	Name, year published, authors, medical specialty, location
Costs included	Based on author reporting we classify studies into one of two categories: • Direct costs only • Direct and indirect costs
Cost perspective	We inductively classify studies into one or more categories: • Provider costs (e.g. hospital) • Payer costs (reimbursements, charges, payments) • Patient costs (out-of-pocket costs to patient)
Care path length	We inductively classify studies into one of the following categories: • Full care path • Full care path, full surgical episode (FSE) • Partial care path, full surgical episode (PSE) • Partial care path
Costing method label	Costing method used, as labelled by the authors. These include traditional cost accounting, ABC, or ABC excluding overheads, TDABC, or TDABC with some cost categories omitted, microcosting, bottom-up clinical costing, reference pricing, relative value units or DRG costs, direct variable costs, or direct costs as an estimate of total cost, reimbursements, charges, claims, payments, and cost-to-charge ratio.

Costing method applied	Costing method applied, based on method described by authors. We classified studies using management accounting literature (e.g., Zimmerman, 2015). We found the following categories represented in the literature.
	• Direct costing
	• Absorption costing, which includes:
	  ○ ABC
	  ○ TDABC.
	  ○ Other
	Cases using reimbursements or charges to estimate costs were coded as 'reimbursements' or 'cost-to-charge ratio'.

Facilitating factors	If the study discussed the consequences of the costing information generated, we collected the consequences. After we collected all consequences, we categorized these inductively.

Note: ABC: Activity-based costing; TDABC: Time-driven activity-based costing

Supplement digital content table 1. Eligibility criteria and data collected.

SUPPLEMENT DIGITAL CONTENT
3 All studies included in RQ1

Perspective	Method	n	studies
Provider	Direct costs only		
	Direct costing	23	[1–23]
	Absorption costing		
	ABC	7	[24–30]
	TDABC	31	[31–61]
	Other	47	[62–108]
	Not specified	3	[109–111]
Insurer	Charges & reimbursements		
	Charges, reimbursements, claims	81	[23,39,112–190]
	Charges adjusted with cost-to charge ratio	25	[108,191–214]
Patient	Out-of-pocket costs to patient	5	[106,126,130,215,216]

Note: Total number of studies here is 222; seven studies measure two cost types[23,38,39,106,108,126,130]. Studies are classified based on actual costs included and methods described, not necessarily the labels used by authors.

Supplement digital content table 2. Overview of cost measurement methods used in value-based healthcare with references

References of all studies included in research question 1
Reference numbers start at 1, these differ from the manuscript.

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PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	pg 0
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	pg1-3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	pg 3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	pg 4 and supplement
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Pg 4 and supplement
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplement
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	pg 6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	pg 6
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	pg 4, supplement
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	pg 4, supplement
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	pg 4, supplement
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	pg 4
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	pg 8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	N/A
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	pg 8
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	pg 4
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A, discussed pg 23
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	pg 5,6, 7
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	pg 5 (flowchart)
Study characteristics	17	Cite each included study and present its characteristics.	pg 7-14, and supplement
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	N/A
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	pg 7-9
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	pg 18-21
	23b	Discuss any limitations of the evidence included in the review.	pg 21
	23c	Discuss any limitations of the review processes used.	pg 21, 4
	23d	Discuss implications of the results for practice, policy, and future research.	pg 18-21
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	pg 4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	supplement
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Funding statement
Competing interests	26	Declare any competing interests of review authors.	Author statement
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Data availability statement

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

PRISMA 2020 for Abstracts Checklist

Section and Topic	Item #	Checklist item	Reported (Yes/No)
TITLE			
Title	1	Identify the report as a systematic review.	yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	yes
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	no
Synthesis of results	6	Specify the methods used to present and synthesise results.	yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	yes
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	yes
Interpretation	10	Provide a general interpretation of the results and important implications.	yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	yes
Registration	12	Provide the register name and registration number.	N/A

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

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Cost measurement in value-based health care: a systematic review

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Title: Cost measurement in value-based health care: a systematic review

Running head: Cost measurement in value-based healthcare

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ABSTRACT

Objective Although value-based healthcare (VBHC) views accurate cost information to be crucial in the pursuit of value, little is known about how the costs of care should be measured. The aim of this review is to identify how costs are currently measured in VBHC, and which cost measurement methods can facilitate VBHC or value-based decision making.

Design Two reviewers systematically search the PubMed/MEDLINE, Embase, EBSCOhost, and Web of Science databases for publications up to 1/1/2022 and follow PRISMA guidelines to identify relevant studies for further analysis.

Eligibility criteria Studies should measure the costs of an intervention, treatment, or care path and label the study as 'value-based'. An inductive qualitative approach was used to identify studies that adopted management accounting techniques to identify if or how cost information facilitated VBHC by aiding decision-making.

Results We identified 1,930 studies, of which 215 measured costs in a VBHC setting. Half of these studies measured hospital costs (110, 51.2%) and the rest relied on reimbursement amounts. Sophisticated costing methods that allocate both direct and indirect costs to care paths were seen as able to provide valuable managerial information by facilitating care path adjustments (40), benchmarking (39), the identification of cost drivers (47), and the measurement of total costs or cost savings (26). We found three best practices that were key to success in cost measurement: process mapping (34), expert input (16), and observations (24).

Conclusions Cost information can facilitate VBHC. Time-driven activity-based costing (TDABC) is viewed as the best method although its ability to inform decision-making depends on how it is implemented. While costing short, or partial, care paths and surgical episodes produces accurate cost information, it provides only limited decision-making information. Practitioners are advised to focus on costing full care cycles and to consider both direct and indirect costs through TDABC.

Strengths and limitations

- Using two independent reviewers, this systematic review analyzes all value-based healthcare studies that have to date measured costs to provide a comprehensive comparison of cost measurement methods.
- This research operationalizes the benefits of cost measurement to practitioners by identifying four mechanisms through which cost information facilitates value-based healthcare.
- By comparing the methods used in literature to collect cost information, this study identifies three best practices for practitioners and researchers.
- By limiting the search to studies labelled as 'value-based' in their title or abstract, this review overlooks studies that measure healthcare costs but do not explicitly relate this to value-based healthcare.
- The included studies may have achieved value-based healthcare without reporting this explicitly, and therefore may be overlooked when answering Research Question 2.

INTRODUCTION

To make sound value-based decisions in healthcare, hospital practitioners and healthcare providers require patient-level information on the costs incurred and outcomes achieved in hospitals and other healthcare organizations [1]. This will enable care providers to steer towards better patient-reported outcome measures, better patient-reported experience measures, and clinical outcomes at equal or lower cost [2]. With detailed cost and outcome information, care paths can be continuously optimized [3]. Consequently, value-based healthcare (VBHC) is considered one solution to the financial pressures our global healthcare system places on managers and administrators [1,4,5] based on its promise to streamline care by focusing on desirable outcomes. Additionally, hospitals can benefit from cost information by gaining insight into the sources of costs that can then guide cost-containment strategies. Cost information may therefore facilitate process and quality improvement initiatives pursued by management [6–10]. Furthermore, insight into patient-level or treatment-level costs enables hospitals to negotiate appropriate prices with insurance firms, especially given the trend towards new payment models and away from fee-for-service payments [11,12]. Finally, it is suggested that such treatment-level cost information enables market-based competition among hospitals based on outcomes and prices [13].

Considerable research has addressed the outcome side of Porter's value equation [14]. This value equations suggests that healthcare should pursue 'value', where value is defined as desirable and relevant patient level outcomes divided by the costs of delivering care [1, 2]. Many studies have measured patient-level outcomes from both the patient perspective (e.g., patient-reported outcome measures, patient-reported experience measures) and clinical outcome perspective [15,16]. Less is known about the cost side of this equation. Often, the term 'cost' is conflated with the price paid by insurance firms or patients to the hospital [17,18]. However, prices do not reflect

the costs incurred by hospitals [6,19–21]. Prices paid by insurance firms are negotiated sums that include profit margins for both the insurer and the hospital [22]. They are also impacted by political factors, such as the hospital-payor mix [23] that refers to the range of private and public insurance schemes that make up the hospital's income stream. Finally, fee-for-service payments fail to account for patient-level differences in required care. Reimbursements are therefore considered a poor indicator of costs.

Some authors argue for time-driven activity-based costing (TDABC) as the 'gold standard' of cost measurement in healthcare organizations [3,5,15]. TDABC, in a fine-grained way, matches direct and indirect costs to activities based on the time an activity takes. A care path is made up of many activities, each generating costs. The costs of a care path can thus be calculated by first identifying all costs relevant to each activity, and then summing these costs across the activities [22].

Although the research is growing and results are promising, there is relatively little empirical evidence to support TDABC being the best costing method to enable VBHC since studies rarely compare methods, and often simply use whichever system the investigated hospital or care provider uses. Costing methods differ by how they allocate indirect costs to products or services [24]. Moreover, indirect costs cannot causally be attributed to patients and therefore need to be appropriately allocated. An example of such indirect costs are the salaries of administrative personnel such as the front office staff who welcome patients, coordinate schedules, and manage equipment. While some costing methods ignore this (e.g., direct costing), other methods average indirect costs across days or months, or systematically allocate them to patients. These methods range from imprecise to fine-grained, with TDABC towards the fine-grained end of the scale. This insight is particularly relevant to healthcare since indirect costs are high. The most fine-grained

method is known as activity-based costing (ABC) and allocates indirect costs based on actual units of resources used per activity. In comparison, TDABC allocates indirect costs based on a per-minute cost, making it considerably easier to implement. Costing methods that ignore the indirect costs of a care path underestimate the true costs of the care delivered.

Previous systematic reviews have found that TDABC was able to facilitate VBHC, often highlighting cost savings as a result but without comparing it to alternative methods [3,4,15]. Therefore, we do not know how TDABC compares to other cost measurement methods currently in use. While TDABC may be able to facilitate VBHC [5,15], it is unclear how its benefits compare to other costing methods. For these reasons, the cost side of the value equation remains unclear. To address this challenge, we pose two research questions:

RQ1: Which costing methods are currently being used by practitioners to facilitate VBHC?

RQ2: What are the consequences of applying a specific costing method in VBHC? These consequences may include whether the method enables a cost reduction with equal or better health outcomes or provides sufficient information to further improve a care path.

This comprehensive review draws on management accounting literature to categorize costing methods reported in empirical VBHC literature published over the last two decades (January 1, 2003 to January 1, 2022) into cost measurement methods defined in the literature [24], such as direct costing and absorption costing. Compiling studies in this way revealed four ways through which cost information facilitates VBHC and three best practices.

MATERIALS AND METHODS

Literature search strategy

To identify relevant studies, we systematically searched four major databases: Embase, Medline, Web of Science, and CINAHL EBSCOhost. Our search string (**online supplementary appendix)**

was developed by assessing previously identified relevant papers and was designed to catch all studies that address VBHC and measure the costs of an intervention, care path, or treatment by including the following specific terms:

> *cost*, microcost*, macrocost* AND [meaning in combination with] value-based, value based, OR valuebased

Initial search string testing showed that restricting the search to the phrase "value-based healthcare" excluded too many relevant studies because authors use phases such as "value-based perspective" or "value-based equation" when referring to VBHC. Conversely, the term "value" was too broad and yielded more than 40,000 mostly non-specific results. By using wildcard terms indicated by stars we included many variations on the term 'cost'.

Eligibility criteria, record selection, and data collection

We limited ourselves to peer-reviewed empirical research that measured or estimated costs in a VBHC context. All the inclusion criteria and variables extracted are detailed in the **online supplementary appendix**. The following variables, inspired by Porter [2] and the cost measurement methods defined in the accounting literature, were noted:

- Cost types included (direct vs. indirect).
- Cost perspective (provider, payer, patient).
- Portion of the care path costed (full, partial).
- Cost measurement method used (as labelled by authors, verbatim).
- Cost measurement categories based on accounting definitions, e.g., direct costing, absorption costing, step-down allocation, and other recognized methods [24].
- Consequences of the costing information generated.

Patient and public involvement

This study did not involve patients or the public in designing, executing, or reporting the research.

RESULTS

Record selection

Our four-person (ML, PP, HvE, KA) research group identified 3,275 relevant papers, of which 1,930 remained after removal of duplicates. We conducted a trial screening of 30 papers to test and further specify screening criteria. The screening process comprised two rounds as shown in **Figure 1**. In Round 1, ML and PP screened the titles and abstracts independently. When there was uncertainty about the eligibility of a paper, it was retained for full-text screening following Bramer [25]. We accepted 674 studies based on titles and abstracts, with a Cohen's kappa inter-rater reliability score of 0.78, indicating substantial agreement [26].

In Round 2, both ML and PP screened the full text of all 674 studies independently. Of these, 215 studies were seen as relevant for RQ1, with a Cohen's kappa of 0.76 between ML and PP. HvE was included in any resolution discussions needed. Finally, we assessed whether each paper discussed if or how the costing information facilitated VBHC (RQ2), yielding 49 instances where the costing method facilitated VBHC. This review was not registered.

Figure 1 here

Figure 1. PRISMA flowchart depicting the screening, exclusion and inclusion processes with two reviewers.

Descriptive characteristics

An overview of the included studies is provided in **Table 1**. Our earliest study is from 2005, with an upsurge in studies from 2017 onwards. Just under half (n=98, 45.6%) of studies were published in the last two years. An overwhelming majority are from the US (n= 178, 82.8%). Europe is the second most common continent with 22 (10.6%) studies of which 9 (4.2%) relate to Dutch healthcare.

The three largest medical specialty groups represented are surgical (n=99; 46.0%), oncology (n=37; 17.2%), and pediatrics (n=19; 8.8%). A complete list of the 215 studies included is summarized in the **online supplementary appendix**. Extracted data are available in the **supplementary file**.

Characteristic	n	%
Year published		
2005-2009	3	1.4%
2010-2013	6	2.8%
2014	6	2.8%
2015	7	3.3%
2016	9	4.2%
2017	17	7.9%
2018	28	13.0%
2019	41	19.1%
2020	43	20.0%
2021	51	23.7%
2022 as per 1/1/2022	4	1.9%
Geography		
Americas		84.3%
Brazil	3	
Canada	1	
US *of which*	178	
Boston, 8		
California, 18		
New York, 23		
Texas, 12		
Pennsylvania, 9		
Other states, 108		
Asia		2.3%
China	1	
Iran	1	
Kuwait	1	
Lebanon	1	
Singapore	1	
Europe		10.6%
Andalusia	1	
Germany	1	
Italy	3	
Norway	1	
Serbia	1	
Spain	2	
Netherlands	9	
UK	4	
Oceania		1.9%
Australia	4	
Transcontinental		0.9%
Russia	1	
Turkey	1	

Characteristic	n	%
Topic		
Cardiology	5	2.3%
Dermatology	1	0.5%
Emergency & acute care	11	5.1%
Endocrinology	3	1.4%
Surgical, *of which*	99	46.0%
Appendicitis, 2		
Abdominal, 6		
Bariatric, 2		
Cardiac/Thoracic, 12		
Colon/Rectal, 2		
Endocrine, 2		
Ear/Nose/Throat, 2		
Gallbladder, 2		
Liver, 2		
Neurosurgical, 5		
Orthopedic arthroplasty, 25		
Orthopedic fracture, 12		
Orthopedic rotator cuff repair, 2		
Orthopedic other, 3		
Plastic surgery, 2		
Spine, 13		
other surgical, 5		
Geriatrics	1	0.5%
Gynecology & obstetrics	8	3.7%
Infectious disease	1	0.5%
Internal medicine	12	5.6%
Multiple	3	1.4%
Nephrology	1	0.5%
Neurology	2	0.9%
Oncology	37	17.2%
Ophthalmology	3	1.4%
Orthopedic	1	0.5%
Pain medicine	3	1.4%
Pediatrics *of which*	19	8.8%
Appendicitis, 3		
Emergency & acute care, 2		
Neonatal, 3		
Oncology, 1		
Surgical, 5		
Surgical, plastic surgery, 2		
Other pediatric, 3		
Toxicology	1	0.5%
Urology	4	1.9%

Table 1. Characteristics of value-based healthcare studies that measure costs (n=215).

Which cost measurement methods are currently being used to facilitate VBHC?

To answer RQ1, we look at how costs were measured. A summary of our findings is presented in **Table 2**. The literature contains many overlapping and contradictory terms, as 'costs' can refer to insurer costs, reimbursements, hospital costs, or patient costs. About half of the studies (n=110, 51.2%) take a provider perspective, with costs calculated for the hospital or care facility. Many studies use charges or payments because hospital cost data are unavailable, considering charges to be a relevant proxy. Some studies use terms such as 'costs', 'charges', 'prices', 'payments', and 'reimbursements' interchangeably, making it difficult to differentiate [17,18,27–30]. For example, Jain et al. [17] stated, "The terms reimbursement, cost, and payment have been used interchangeably throughout the text to represent actual amounts paid by insurers." Similarly, Robles et al, [30] explained, "Total hospital charges were utilized in this standardized costing analysis. Hospital charge data provides a relative measure of the 'cost' of episodes of care, as actual cost data are generally not ascertainable in the healthcare setting." When calculating costs using TDABC, Ahluwalia et al. [31] called these costs 'prices.' To try to address this confusion, some recent studies refer to provider costs as the 'true cost' of care [6,7,9,19]. Some studies that compare several cost types [19,20] also differentiate 'traditional hospital accounting' costs from 'true costs' calculated with TDABC [6,9,20,32,33].

Characteristic	Studies n	Studies %	Perspectives n	Perspectives %		
Cost perspective						
Provider	110	51.2%	111	51.6%		
Insurer	103	47.9%	106	49.3%		
Patient	2	0.9%	5	2.3%		
N*	215		222			
	All studies (n=215)				Provider only	Payer only
Cost types included						
Direct	28		13.0%		24	2
Direct and indirect	177		81.9%		84	93
Unspecified	10		4.6%		2	8
Costs measurement implementation						
No, costs measured for purpose of study	34		15.7%		33	
Yes, costing method is implemented	39		17.6%		39	
Unspecified or not applicable	142		66.2%		38	102
Costs coverage						
Full care path	47		21.8%		30	16
Full care path (full surgical episode)	17		7.4%		13	4
Partial care path (full surgical episode)	22		8.3%		19	3
Partial care path	86		42.1%		37	49
Unspecified	43		19.9%		11	31

Note: N differs between studies and perspectives because seven studies measured two cost types.

Table 2. Characteristics of costing methods in value-based health care

We categorized studies based on the cost types included. Both direct and indirect costs were considered in 177 (81.9%) studies, while 28 (13.0%) papers only included direct costs.

Next, we looked at whether costs were calculated for a complete care path. We found 64 (29.8%) studies that measured costs for a full care path, of which 16 (7.4%) refer to full surgical episodes and label them as such without considering all the pre- or post-surgical costs. The remaining 86 (42.1%) measure costs of a partial care path.

Table 3 categorizes studies based on the costing method used. In those papers measuring costs within a care provider, we identified two clear categories that were in line with the

management accounting literature [24]. The first is 'direct costing' (n=23), where direct costs of care are summed and indirect costs ignored. This implies that, if costs cannot be causally attributed to the treatment of a specific patient, they are not considered and hence overlooked when making managerial decisions [24].

The second category of studies considers both direct and indirect costs and uses 'absorption costing', whereby indirect costs are allocated to patients based on an allocation key (a type of formula used for allocating indirect costs) [31]. These studies include but are not limited to TDABC (n=31) and ABC (n=7), where costs are allocated to individual care activities (such as a consultation or treatment step). The remaining absorption costing papers (n=47) also consider direct and indirect costs but do not report how indirect costs are allocated to activities. In the absorption costing studies, authors may state that cost information was calculated based on diagnosis-related group costs, micro-costing, bottom-up clinical costing, or hospital accounting systems not further classified. A full list of all the terms used is presented in the **online supplementary appendix.**

Perspective	Method	n
Provider	Direct costs only	
	Direct costing	23
	Absorption costing	
	ABC	7
	TDABC	31
	Other	47
	Not specified	3
Insurer	Charges and reimbursements	
	Charges, reimbursements, claims	81
	Charges adjusted with cost-to-charge ratio	25
Patient	Out-of-pocket costs to patient	5

Note: The total number of studies here is 222 because 7 studies measure two cost types. Studies are classified based on actual costs included and methods described, not necessarily the labels used by the studies' authors.

Table 3. Overview of cost measurement methods used in value-based healthcare

How do these costing methods facilitate VBHC?

To answer RQ2, we extracted all the consequences related to the costing method as described in the papers. Here, like Etges et al. [3], we were looking for how the costing information facilitated VBHC. Note that not all the studies included to address RQ1 describe facilitating VBHC or the consequences of the cost information generated. The reported consequences were grouped inductively, revealing four categories:

1. Identification of cost drivers, in terms of cost items (e.g., staff costs, material costs) or activities (e.g., surgery, initial consult; n=48).
2. Comparison of costs across patient groups, care providers, or procedures (n=39).
3. Measured cost difference, or cost saving, while achieving equal or better care (n=26).
4. Suggested or measured care path improvements (n=40).

These studies are presented in **Table 4**. The studies reporting these facilitators used ABC (n=6), TDABC (n=29), other absorption costing methods (n=12), or direct costing (n=3).

Study Characteristics						Best practices				Value-Based consequences of costing information			
	Medical Specialty	Costing method	period	Centre	Study type	PM	EI	DO	CG	Compare costs across	ICD	MPS	Care path adjustment
[34]	Internal medicine	TDABC	partial	single	retro	yes	yes		items, activities		yes		suggested
[33]	Surgical, orthopedic, rotator cuff repair	TDABC	full (FSE)	single	retro	yes		yes	items, activities	surgeons, two alternative treatments	yes	yes, ± $727 about the mean per patient	suggested
[4]	Cardiology, surgical	TDABC	full (FSE)	multi	retro	yes	yes	yes	items, activities	hospitals, procedures	yes	yes, estimate 51.0% of procedure cost	yes
[10]	Oncology	TDABC	full	single	retro	yes	yes	yes	items, activities	treatment care paths	yes	$2,302 (25.0%) difference across treatments	suggested
[35]	Surgical, orthopedic	TDABC	full (FSE)	single	retro	yes			items, activities	patients	yes		suggested
[36]	Surgical, orthopedic	TDABC	full (FSE)	single	retro	yes			items, activities	patients	yes		suggested
[19]	Surgical, orthopedic	TDABC	full (FSE)	single	retro	yes		yes	items, activities	costing methods (TA and TDABC)	yes		suggested
[20]	Surgical, orthopedic	TDABC	full (FSE)	single	retro	yes		yes	items, activities	five treatments, cost vs. reimbursement	yes		
[37]	Pediatric, surgical, plastic surgery	TDABC	full (FSE)	multi	pro	yes		yes	items, activities	treatment care paths	yes	up to $8900, but long-term outcomes yet unknown	suggested
[38]	Emergency & acute care	TDABC	full (multiple)	multi	retro	yes	yes	yes	items, activities	eight care paths for acute ureteral stones (patient journeys)	yes	yes, $6614 difference across care paths	suggested
[39]	Surgical, orthopedic	TDABC	full (FSE)	single	retro	yes		yes	items, activities	surgeons	yes		suggested
[40]	Oncology	TDABC	partial	single	pro	yes	yes	yes	items, activities	treatments and individual care paths	yes	yes, cost difference of up to 3.33 times, depending on case mix	suggested
[41]	Oncology (incl. surgery)	TDABC	full	single	retro	yes		yes	items, activities		yes		suggested
[42]	Oncology	TDABC	partial (FSE)	single	retro	yes			items	pre and post implementation	yes	yes, mean cost savings of €309 per patient	yes
[43]	Cardiology	AC (other)	partial	multi	retro				items	patient journeys	yes		suggested
[44]	Emergency & acute care	AC (other)	partial	single	retro	yes			items	surgeons	yes		
[45]	Surgical, bariatric	AC (other)	full (FSE)	single	retro				items	treatment	yes		
[46]	Gynecology & obstetrics	AC (other)	full	single	retro	yes			items, activities	procedures	yes	yes, $967 per patient	suggested
[47]	Emergency & acute care	AC (other)	partial	single	retro				items, activities		yes		
[48]	Surgical, colorectal	AC (other)	partial (FSE)	single	retro				items	intervention	yes	yes, reduced variable cost, similar total cost	yes
[21]	Surgical, orthopedics, fracture	ABC	partial (FSE)	single	retro				items	patients, patient groups, demographics	yes		
[49]	Surgical, orthopedic, arthroplasty	ABC	full (FSE)	single	both		yes	yes	items, activities	treatment care paths	yes	estimate €2,054,000 annually	yes
[50]	Surgical, spine	ABC	Full	single	retro	yes			items, activities	patients, patient groups	yes		suggested
[6]	Pediatric, surgical	TDABC	full (FSE)	single	both	yes		yes	items, activities	costing methods (TA and TDABC)	yes	20.0% and without care path alteration	suggested
[51]	Oncology	TDABC	full (FSE)	single	retro	yes	yes	yes	items, activities	treatment care paths	yes	yes, estimate for each 10.0% decrease in case duration, total costs could decrease by about 8.0%.	suggested
[31]	Surgical, orthopedic	TDABC	full (FSE)	single	pro	yes	yes	yes	items, activities	treatment care paths	yes	£2,018 per patient	suggested
[52]	Pediatric, neonatal	TDABC	partial	single	retro	yes	yes	yes	items, activities	Pre and post intervention	yes	yes, 36.0% or $92,000 per tracheostomy care cycle	yes
[53]	Surgical, cardiac/thoracic	AC (other)	partial	multi	retro	yes			items	patients, implant devices	yes		suggested

[54]	Oncology, surgical	AC (other)	partial	single	retro				items		yes	yes, multiple	
[55]	Multiple	TDABC	full	multi, pilot	retro	yes	yes	yes	items, activities	before and after intervention (IPUs)	yes	yes, quarterly costs declined	suggested
[56]	Oncology	TDABC	partial (PSE)	single	pro	yes		yes	items, activities	treatment care paths (parallel vs. induction design in OR)	yes	yes, estimate OR time reduction of 55 min, or $,2818 missed revenue	suggested
[57]	Surgical, orthopedics fracture	TDABC	partial (FSE)	single	both	yes			items		yes		suggested
[58]	Surgical, foot debridement	TDABC	partial (FSE)	single	retro			yes	items	before and after intervention	yes		yes
[59]	Ophthalmology	TDABC	full	single	retro	yes	yes	yes	items, activities		yes		suggested
[60]	Gynecology & obstetrics, surgical	AC (other)	partial (FSE)	single	retro				items		yes		suggested
[61]	Gynecology & obstetrics, surgical	AC (other)	partial (FSE)	single	retro				items		yes		
[62]	Multiple	Direct costing	partial	single	retro				items		yes		
[63]	Surgical, orthopedic	Direct costing	full (FSE)	multi	retro				items	intervention		yes, £255 per patient	yes
[5]	Surgical, carpal tunnel release	TDABC	partial (FSE)	multi	retro	yes		yes	items, activities	multiple treatment care paths	yes	yes, 70.9% ($27,103) and 31.6% ($178)	yes
[64]	Surgical, appendicitis	AC (other)	partial (FSE)	single	pro		yes	yes	items	pre and post intervention (dashboard)	yes	yes, decreased by $496 per operation	yes
[65]	Surgical, orthopedic	Direct costing	partial (FSE)	single	retro		yes		items	intervention	yes		
[8]	Urology	TDABC	partial	single	pro	yes		yes	items, activities		yes	yes, estimate two hours per cycle	suggested
[66]	Pediatrics, appendicitis	TDABC	full (FSE)	single	pro	yes	yes	yes	items, activities	treatment care paths (pre and post intervention)	yes	11.0% cost reduction, and 51.0% hospitalization time reduction	yes, several
[67]	Urology	AC (other)	partial	multi	retro		yes		items				
[7]	Oncology, surgical, 11 surgeries	TDABC	Partial (FSEs)	single	retro	yes			items, activities	potential staffing ratios	yes	estimate 13.0-28.0% per surgery type	modelled and suggested
[9]	Oncology	TDABC	full	single	retro	yes	yes	yes	items, activities	treatments (high-dose vs. low-dose brachytherapy)	yes	$2,668 difference across treatments	yes
[68]	Urology	TDABC	partial (FSE)	single	retro	yes	yes		items, activities	five treatment care paths	yes	yes, 400.0% increase from least to most expensive pathways	suggested
[32]	Surgical, neurosurgery	ABC	partial (FSE)	single	retro	yes			items, activities	patients	yes	yes, 25.0%	yes, several
[69]	Surgical, neurosurgery	ABC	partial (FSE)	single	retro	yes			items, activities	patients	yes		suggested
[70]	Pediatric plastic surgery	ABC	partial, 1 year	single	retro				items	patients	yes		suggested
					Count	***34***	***16***	***24***		***39***	***47***	***26***	***40***

Note: ABC: Activity-Based costing; TDABC: Time-Driven activity-based costing; FSE: Full surgical episode; AC (other): Absorption costing, other; PSE: Partial surgical episode; Retro: Retrospective; Pro: Prospective; PM: Process mapping; EI: Expert input; DO: Direct Observation; CG: Cost grouping, cost items only or activities; ICD: Identify cost drivers; MPS: Measured provider cost savings (at equal or better care). Costing methods are classified based on actual reported costs and methods applied, not necessarily the labels used by authors.

Table 4. Costing method applications, method used, and consequences (ordered by year).

Activity-based costing

The six studies applying ABC justified this on the basis that it was the care provider's existing costing method. Three of these studies measured costs for a full surgical episode [21,32,69] as part of a longer care path, two measured costs for a full care path [49,50], and one measured costs of a partial care path [70]. While these studies all applied ABC, the ability to facilitate VBHC differed. Jacobs et al. [50] measured costs for a complete care path for patients with adult spinal deformity, a complex care path spanning about one year. The authors compared costs across patient groups and patients, identified major cost drivers, and suggested where to concentrate cost containment. Similarly, McLaughlin and colleagues [32,69] measured costs, identified cost drivers, and evaluated targeted cost containment initiatives. In one paper [32], the cost containment initiatives were informed by the cost information: activities with the highest costs were targeted for savings and a 25% reduction in total costs was achieved. In the other paper [69] they identified comorbidities and demographics that were strongly related to the total costs of patients undergoing neurosurgery, whereas Wise et al. [21] did not for geriatric hip-fracture patients while identifying cost drivers and comparing costs across patient groups. Vanni et al. [49] successfully predicted about €2 million annual cost savings associated with an enhanced recovery pathway.

Time-driven activity-based costing

The majority of the papers used to answer RQ2 involved TDABC. Significant cost drivers were identified linked to activities in a care path, and some suggested where to target improvement initiatives [4,6–8,10,33,40,59]. Many of the TDABC studies were able to suggest [6,8,10,19,33–38,40,41,51,55–59,68] or measure [5,9,31,42,52,66] care path improvements (see **Table 4**).

The lengths and specificities of the care path costs varied widely. Some studies were narrow in scope, calculating costs for subsections of a single care path or surgical procedure [6,8,38,39,56].

Isaacson et al. [8] calculated costs for cleaning a single reusable piece of equipment, while others costed single surgical days [6], compared alternative surgeons [39], or anesthesia solutions within a care path [56]. Within this group, McClintock et al. [38] took the broadest perspective by mapping individual patient journeys.

The largest group (n=10) of TDABC studies measured costs across care paths within a single provider and for a single diagnosis [9,10,31,33,37,40–42,51,66]. Typically, these studies compared costs between a new intervention and the 'usual' care [9,10,31,51,52,66], or between alternative care paths [33,37,40,42] in order to measure cost savings.

Some studies were broader in scope, costing multiple care paths or treatments within one specialty [5,7,20,68], an entire department [34,59], multiple practice units [55], or providers [4]. Some compared 'true costs' calculated using TDABC across care providers within specialties or care paths [4,37], while others argued that TDABC costs were too subjective to be compared across hospitals [10,38]. While most studies compared costs across care paths, some also compared costs across patient groups [19,35,36], or even individual patient journeys [38,40].

Technology played a prominent role in studies aiming to reduce costs. One study was able to suggest how to use technology more efficiently [6], and some, by integrating technological investments in the calculated TDABC costs, show how technology can reduce costs [37,40,51].

Conversely, studies using unspecified absorption methods [60,61] did not include investments in technology, and this is surprising since absorption costing methods require indirect costs to be allocated.

Analyses enabled by activity-based and time-driven activity-based costing

Several of the ABC and TDABC studies compared costs calculated using traditional accounting costs [6,19,20] or reimbursement amounts [20,21] and found that prices do not equal costs. Some carried out quantitative analyses using cost information generated using ABC or TDABC including regression analyses to identify correlations [7,33,35,36,40], compare patient groups [20,35,36], and compare costs and outcomes across a matched patient sample [40].

Two recent studies [33,57] have conducted patient-level value analyses (PLVAs), comparing patient-reported outcomes with patient-level TDABC costs. Wise et al. [33] did so for rotator cuff repair surgery over a period of one year, while McCreary et al. [57] analyzed ankle fractures. Both studies found costs to be unrelated to patient-reported outcome measures, highlighting the need for further research. This suggests that patient-reported outcome measures are not strongly associated with the costs of the care delivered, and that patient satisfaction may depend on other factors such as their perceived experience with healthcare professionals.

Other absorption costing methods and direct costing

Other absorption costing methods reported in the studies were labelled as micro-costing (n=5), bottom-up clinical costing [47], or were described but not labelled (n=6). Most were able to identify cost drivers (n=12, for details see **Table 4**) and some compared costs within providers. Notably, Robinson et al. [64] used the cost information to build and evaluate a dashboard that provides real-time feedback to surgeons during operations and monthly summaries and thereby decreases costs significantly. Some studies omitted certain cost categories such as equipment [61]. Direct costing enabled cost drivers to be identified [62,63,65], and in some cases granular cost measurement.

Best practices

Having identified these four facilitators, we compared studies to find common practices. This is particularly useful because costing methods are not labelled consistently. For example, many studies refer to ABC as 'bottom-up costing.' To look beyond labels, we compared the actual methodologies used to measure costs. We found that studies that were able to facilitate VBHC used process mapping (n=34), expert input (n=17), and/or direct observations (n=24) when measuring costs. These practices overlap with TDABC best practices, but are not exclusive to TDABC, as shown in **Table 4**.

Studies that made specific care path improvement suggestions used process mapping, and especially those involving multidisciplinary teams reported significant benefits [4,9,10,19]. This approach enabled experts (doctors, care professionals, administrators) with the required knowledge and experience to reflect critically on the process [4,9,10,19], resulting in actionable suggestions. In comparison, studies that did not use process mapping tended to suggest minimizing high-cost items (e.g., total operating time, nursing costs) but were unable to couple these suggestions to specific activities or to chronological points in the care path. Commenting only on cost items, and not identifying chronological points, limits the ability of cost information to steer management towards where to focus process improvement initiatives.

Expert input while creating process maps or measuring costs was often cited by authors as valuable, especially for estimating preparation time or other behind-the-scenes activities that do not involve the patient but are critical to delivering care. Some studies that could not call on expert input cited this as a limitation. A few cases also evaluated the impact of costing information, for example by involving experts to evaluate a dashboard [64].

Finally, some studies involved direct observations, particularly those that calculated process times to the minute or measured the costs of individual patient journeys.

DISCUSSION

This review focused on VBHC studies that have measured or estimated costs, and on identifying which costing methods can facilitate VBHC. By assessing the consequences of the costing methods used, we were able to identify characteristics of costing methods that do facilitate VBHC.

Previous research found that TDABC can facilitate VBHC through cost containment and process improvements [3,15]. We built on this by comparing value-based consequences across costing methods. While the field is young and alternatives seem limited, we have found considerable evidence that TDABC and ABC can indeed facilitate VBHC. As previously noted, TDABC is considerably easier to implement than ABC, which leads us to recommend it over ABC. We found no well-documented alternatives to TDABC or ABC in our review. However, not all the TDABC studies delivered the facilitating factors we have identified. We therefore emphasize the need to follow TDABC guidelines carefully and to explicitly document methods used. Several of the studies in this review simply stated that TDABC was applied, outsourced, used with incomplete costs, or used without listing exact cost rates.

The start and end points of care paths tend to be well documented by authors but are inconsistent. To view costs in relation to outcomes, as suggested by Porter [2], the total costs from start to finish of a trajectory should be included [71]. In many studies, the start and end points of cost measurement windows seem somewhat arbitrary but are still labeled as full care paths. Consequently, this results in inconsistencies across studies, hindering comparisons. Encouragingly, some of the more recent studies have measured costs across a genuine full care path and future research should do the same, explicitly defining start and end points. This would enable consistent comparisons across providers. As with the ICHOM standard outcome sets produced by the International Consortium for Health Outcomes Measurement, costs could be

catalogued and compared over full care paths. Indeed, in a recent expert consensus study, experts agreed on the need to focus on full care paths [71].

Furthermore, we can see a trade-off in the specificity and length of the care path costed. Studies that measure costs for elements of a care path (such as a surgical operation) can provide detailed costs for that portion of the care path, but not total care costs for a patient because the remainder of the care path is not included. Some surgical studies measured costs for partial care paths, and often concluded that operating theatre time should be minimized due to high surgeon and operating theatre costs. However, this conclusion has limited relevance for the value equation [13] because it does not provide cost information for an entire care path, or advice on how to circumvent surgery.

Studies that cost complete care paths appear to use less-detailed costing methods (due to the sheer length of the care path) but are able to compute total costs of a patient's care. This enabled benchmarking across providers, as well as cost comparisons of new vs. standard care, or of treatment alternatives. This allowed providers to steer towards lower-cost outcomes to maximize value. Future research should focus on measuring costs for full care paths, and on comparing costs to outcomes as demonstrated in some of the more recently published studies in our review [33,40,57].

Our review highlights the need to involve medical professionals in this process, both when implementing costing methods as well as when evaluating the results. Future cost measurement studies, and hospitals looking to implement TDABC, should involve multidisciplinary teams. Studies that have involved medical professionals in the process of measuring costs and then using the findings were able to improve care paths through improvement initiatives and/or dashboards. This suggests that generating and using costing information should be viewed as a process. Future

qualitative research should follow this process to better understand the mechanisms through which cost information impacts decision making, and the impact that staff involvement has on cost containment. Previous research suggests that staff involvement is critical as it builds trust in the accuracy of the data [72].

Limitations and future research

We must acknowledge several limitations related to the scope, breadth, and quality of the included studies. First, our search strategy will have missed studies that measure costs but do not label the study as VBHC-oriented. Not all TDABC studies make value-based claims or contributions and may therefore be overlooked in our review. Additionally, not all studies explicitly discuss the impact or consequences of the costing method applied, which may impact our findings. Future qualitative research could usefully investigate TDABC implementations and evaluate whether the facilitating factors found in this review are achieved. Second, sophisticated methods such as TDABC are currently only used with predictable and/or short care paths such as orthopedic surgery. Further research testing the feasibility and practicality of TDABC in different settings, such as emergency on-call care, or longer care paths such as fertility treatment, is warranted. Further, our findings may have limited generalizability across medical specialties as indicated in **Table 1**. Finally, we have relied on the reporting of authors whose style and quality differs across disciplines and journals. To an extent we circumvented this limitation by looking beyond the cost measurement labels used by authors, extracting the costs included and methods used, and then categorizing them using established accounting definitions. However, we cannot exclude the possibility of errors due to a lack of explicit reporting in some of the studies reviewed.

Conclusions

This systematic review reveals that cost information, at the treatment or patient level, for complete care paths does enable value-based decision making through several mechanisms. Such cost information can direct quality and process improvement initiatives alongside informing appropriate reimbursement levels. In the pursuit of VBHC, practitioners and academics are advised to apply ABC or TDABC to estimate costs, using process mapping, expert input, and observations, rather than relying on pricing information.

Patient and public involvement: This study did not involve patients or the public in designing, executing or reporting of the research.

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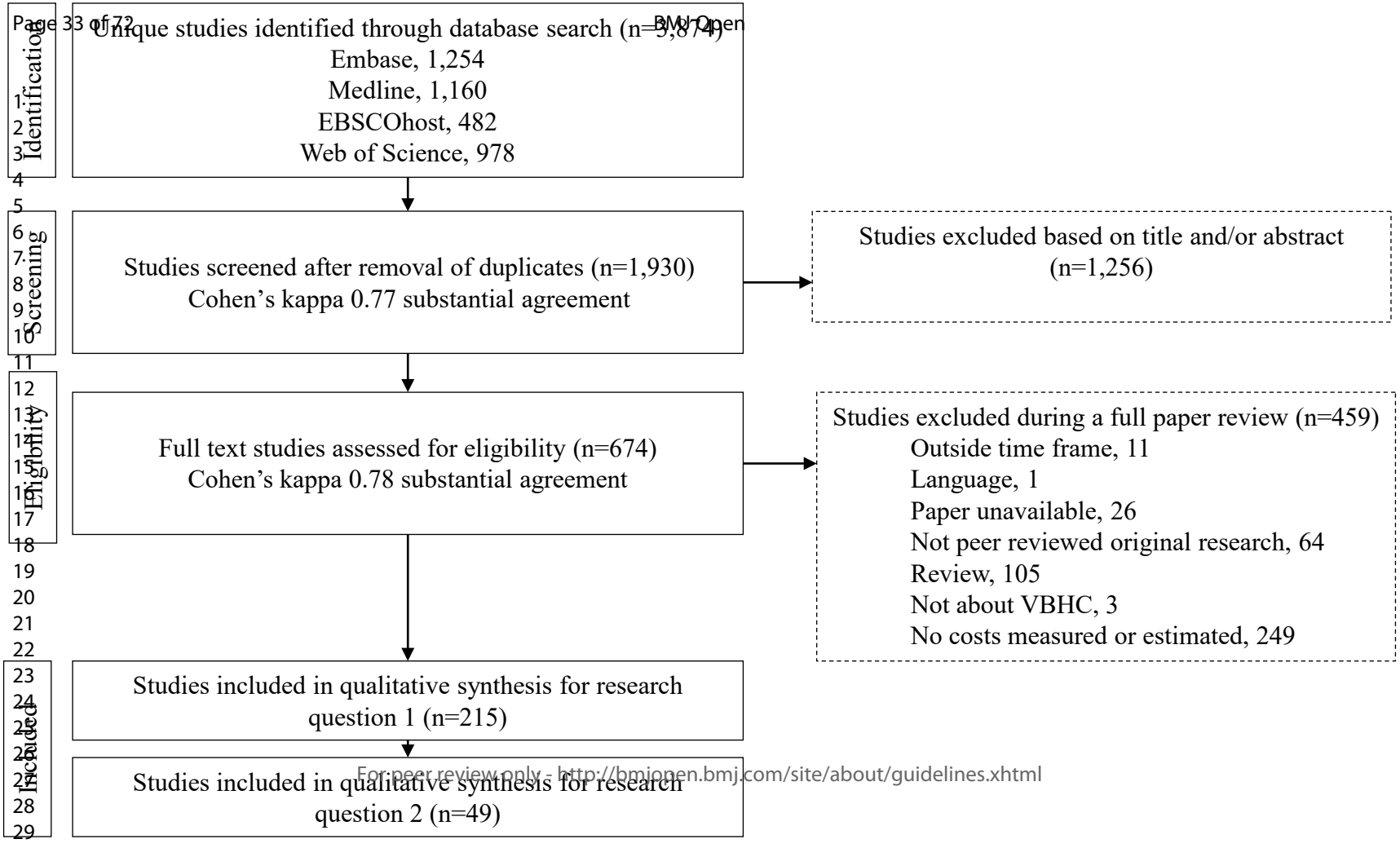

SUPPLEMENT DIGITAL CONTENT
1 Search strategy
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TS=((((value-based OR valuebased) NOT ((value-based OR valuebased) NEAR/2 (insuran* OR purchas* OR pric* OR reimburse* OR contract* OR payment* OR partnership*)) OR vbhc OR vb-hc)) AND ((cost OR costs OR costing OR microcosting OR macrocosting OR tdabc OR abc OR (resource NEAR/2 assignment*) OR (direct* NEAR/2 estimat*))) AND (care OR health* OR medicine OR clinical OR hospital* OR surger* OR therap* OR patient* OR oncolog* OR drugs OR medication* OR cancer* OR pharmac*)) NOT TI=(cost NEAR/1 (eval* OR benefit* OR effectiv* OR utilit* OR consequen* OR minimi* OR outcome* OR reduc* OR saving*)) AND DT=(article) AND LA=(dutch OR english)

SUPPLEMENT DIGITAL CONTENT
2 Inclusion/exclusion criteria, data extracted

Eligibility criteria	
Language	English or Dutch
Publication date	Between 2003 and 1.1.2022
Research type	Original, peer-reviewed, empirical research
Terms	Any variation of the terms "cost" and "value-based" in title or abstract
Full text content	Costs of an intervention, treatment, care path, or other healthcare activity must have been measured or estimated.
Variables collected	
Descriptive	Name, year published, authors, medical specialty, location
Costs included	Based on author reporting we classify studies into one of two categories: • Direct costs only • Direct and indirect costs
Cost perspective	We inductively classify studies into one or more categories: • Provider costs (e.g. hospital) • Payer costs (reimbursements, charges, payments) • Patient costs (out-of-pocket costs to patient)
Care path length	We inductively classify studies into one of the following categories: • Full care path • Full care path, full surgical episode (FSE) • Partial care path, full surgical episode (PSE) • Partial care path
Costing method label	Costing method used, as labelled by the authors. These include traditional cost accounting, ABC, or ABC excluding overheads, TDABC, or TDABC with some cost categories omitted, microcosting, bottom-up clinical costing, reference pricing, relative value units or DRG costs, direct variable costs, or direct costs as an estimate of total cost, reimbursements, charges, claims, payments, and cost-to-charge ratio.

Costing method applied	Costing method applied, based on method described by authors. We classified studies using management accounting literature (e.g., Zimmerman, 2015). We found the following categories represented in the literature.
	• Direct costing
	• Absorption costing, which includes:
	  ○ ABC
	  ○ TDABC.
	  ○ Other
	Cases using reimbursements or charges to estimate costs were coded as 'reimbursements' or 'cost-to-charge ratio'.

Facilitating factors	If the study discussed the consequences of the costing information generated, we collected the consequences. After we collected all consequences, we categorized these inductively.

Note: ABC: Activity-based costing; TDABC: Time-driven activity-based costing

Supplement digital content table 1. Eligibility criteria and data collected.

SUPPLEMENT DIGITAL CONTENT
3 All studies included in RQ1

Perspective	Method	n	studies
Provider	Direct costs only		
	Direct costing	23	[1–23]
	Absorption costing		
	ABC	7	[24–30]
	TDABC	31	[31–61]
	Other	47	[62–108]
	Not specified	3	[109–111]
Insurer	Charges & reimbursements		
	Charges, reimbursements, claims	81	[23,39,112–190]
	Charges adjusted with cost-to charge ratio	25	[108,191–214]
Patient	Out-of-pocket costs to patient	5	[106,126,130,215,216]

Note: Total number of studies here is 222; seven studies measure two cost types[23,38,39,106,108,126,130]. Studies are classified based on actual costs included and methods described, not necessarily the labels used by authors.

Supplement digital content table 2. Overview of cost measurement methods used in value-based healthcare with references

References of all studies included in research question 1
Reference numbers start at 1, these differ from the manuscript.

1 Chatfield SC, Volpicelli FM, Adler NM, *et al.* Bending the cost curve: Time series analysis of a value transformation programme at an academic medical centre. *BMJ Qual Saf* 2019;**28**:449–58.

2 Featherall J, Brigati DP, Arney AN, *et al.* Effects of a Total Knee Arthroplasty Care Pathway on Cost, Quality, and Patient Experience: Toward Measuring the Triple Aim. *J Arthroplasty* 2019;**34**:2561–8.

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Inclusions RQ1 (215) extracted data to be shared with Erasmus Data Repository (FigShare)

Authors	Year Pub	Title paper (see full reference in manuscript)	Geography (country) of study	Geography, state of country, if N/A country	study design (if incl. in RQ2)	unit of analysis	disease/topic labels provided by study (overlapping tags, can be multiple)	Medical Specialty (non overlapping labels)	Medical Specialty sub category, where applicable	Care path studied	Costs included	Costs perspective (all)	Primary Cost perspective	Secondary Cost perspective if applicable	Costing method used as described in study	Primary Costing method classification	Secondary Costing method classification, if applicable	Implementation of costing method (N/A if reimbursements or charges, unspecified if not discussed in study)	if reimbursement; actual measurement used for estimation	RQ2 included - discuss consequences or impact of cost information in study
Gálvez, A. C. M. Sánchez, F. J. Moreno, C. A. Pérez Fernández, A. J. García, R. B. López, M. C. Ramírez, M. P. P.	2020	Value-based healthcare in ostomies	Andalusia	Andalusia		71 surgical ostopmy patients	digestive, urology, surgical	Urology		partial care path (full surgical episode)	Direct and indirect	provider	provider		unspecified	Absorption costing - unspecified/generic		Paper only		no
McLaughlin, N. Upadhyaya, P. Buxey, F. Martin, N. A.	2014	Value-based neurosurgery: Measuring and reducing the cost of microvascular decompression surgery	US	US; California	single center, retrospective	44 neurosurgical patients	neurosurgical, microvascular decompression, trigeminal neuralgia (TN) or hemifacial spasm (HFS)	Surgical	Neurosurgery	partial care path (full surgical episode)	Direct and indirect	provider	provider		ABC	Absorption costing - ABC		implemented		yes see second sheet
Hennink, S. D. Hofland, N. Gopie, J. P. Van Der Kaa, C. De Koning, K. Nielsen, M. Tops, C.	2016	Value-based healthcare in Lynch syndrome	The Netherlands	The Netherlands		64 Lynch Syndrome patients	oncology, lynch syndrome, colorectal cancer	Oncology		full care path	Direct and indirect	provider	provider		unspecified	Absorption costing - unspecified/generic		unspecified		no
French, K. E. Guzman, A. B. Rubio, A. C. Frenzel, J. C. Feeley, T. W.	2016	Value based care and bundled payments: Anesthesia care costs for outpatient oncology surgery using time-driven activity-based costing	US	US; Virginia	single center, retrospective, multiple care paths	5,357 outpatient anesthesia cases across 11 procedure groups	oncology	Oncology		partial care path (full surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		implemented		yes see second sheet
Tan, R. Y. C. Met-Domestici, M. Zhou, K. Guzman, A. B. Lim, S. T. Soo, K. C. Feeley, T. W.	2016	Using quality improvement methods and time-driven activity-based costing to improve value-based cancer care delivery at a Cancer Genetics clinic	Singapore	Singapore	single center, retrospective, process mapping, observation	251 Patients with high-risk features suggestive ofhereditarycancer	oncology, genetics, Cancer genetics	Oncology		partial care path	Direct	provider	provider		TDABC	Direct costing		unspecified		no
Danilyants, N. MacKoul, P. Baxi, R. van der Does, L. Q. Haworth, L. R.	2019	Value-based assessment of hysterectomy approaches	US	US; Maryland	single center, retrospective	2689 patients, female, 18 or over	gynecology, vaginal hysterectomy, robot, robot-assisted	gynecology & obstetrics		partial care path (full surgical episode)	Direct and indirect	provider	provider		Microcosting supplemented with charges	Absorption costing - unspecified/generic		Paper only		yes see second sheet
Hernandez, A. Kaplan, R. S. Witkowski, M. L. Forrest Faison, C. Porter, M. E.	2019	Navy medicine introduces value-based health care	US	US; Florida	single center, retrospective, multiple care paths, pilot project	22877 patients total	pregnancy, osteoarthritis, diabetes, lower back pain, multiple	gynecology & obstetrics		full care path	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		implemented		yes see second sheet
Parra, E. Arenas, M. D. Alonso, M. Martínez, M. F. Gamen, Á Aguarón, J. Escobar, M. T.	2017	Assessing value-based health care delivery for haemodialysis	Spain	Spain	multi center, retrospective	5 haemodialysis treatment centers, patients unspecified	haemodialysis, renal	Urology		partial care path	Direct and indirect	provider	provider		Microcosting	Absorption costing - unspecified/generic		Paper only		yes see second sheet
Brown, G. C. Brown, M. M. Brown, H. C. Kindermann, S. Sharma, S.	2007	A Value-Based Medicine Comparison of Interventions for Subfoveal Neovascular Macular Degeneration	US	US; Pennsylvania		233 patients with age-related macular degeneration	Ophthalmology, Neovascular, macular degeneration	opthalmology		partial care path	Direct	payer	payer		none, reimbursements	Charges/Reimbursement-based		N/A	average medicare reimbursements	no
Medbery, R. L. Chadid, T. S. Sweeney, J. F. Knechtle, S. J. Kooby, D. A. Maithel, S. K. Lin, E.	2014	Laparoscopic vs open right hepatectomy: A value-based analysis	US	US; Georgia		105 patients total, elective laparoscopic liver resection surgery or open right hepatectomy	Surgical, Hepatectomy, Laparoscopic liver resections	Surgical	Liver	partial care path	Direct and indirect	provider	provider		unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic		implemented		no
Danilyants, N. MacKoul, P. van der Does, L. Haworth, L. Baxi, R.	2019	A value-based evaluation of minimally invasive hysterectomy approaches	US	US; Maryland	single center, retrospective	2689 patients, female, 18 or over	gynecology, vaginal hysterectomy, robot, robot-assisted	gynecology & obstetrics		partial care path (full surgical episode)	Direct and indirect	provider	provider		Microcosting	Absorption costing - unspecified/generic		Paper only		yes see second sheet
Gabriel, L. Casey, J. Gee, M. Palmer, C. Sinha, J. Moxham, J. Calvert-Stone, T. L.	2019	Value-based healthcare analysis of joint replacement surgery for patients with primary hip osteoarthritis	UK	UK; London		50 patients primary hip osteoarthritis	orthopedics, joint replacement, total hip replacement, Hip osteoarthritis	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	provider	provider		Patient Level Information Costing System methodology (PLICS)	Absorption costing - unspecified/generic		implemented		no
Van Deen, W. K. Spiro, A. Burak Ozbay, A. Skup, M. Centeno, A. Duran, N. E. Leary, B. N.	2017	The impact of value-based healthcare for inflammatory bowel diseases on healthcare utilization: A pilot study	US	US; California		60 patients with inflamatory bowel disease	IBS, bowel, Inflamatory bowel disease	Internal Medicine		full care path	Direct and indirect	payer	payer		none, reimbursements	Charges/Reimbursement-based		N/A	Medicare reimbursements based on DRG/HCPS codes	no

Isaacson, D. Ahmad, T. Metzler, I. Tzou, D. T. Taguchi, K. Usawachintachit, M. Zetumer, S.	2017	Defining the Costs of Reusable Flexible Ureteroscope Reprocessing Using Time-Driven Activity-Based Costing	US	US; California	single center, direct observation, process mapping	10 Uteroscopes	Urology, Ureteroreneoscopy	Urology		partial care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Ionov, M. V. Zhukova, O. V. Yudina, Y. S. Avdonina, N. G. Emelyanov, I. V. Kurapeev, D. I. Zvartau, N. E.	2020	Value-based approach to blood pressure telemonitoring and remote counseling in hypertensive patients	Russia	Russia		240 hypertensive patients	Blood pressure, hyperternsion, Blood pressure telemonitoring and remote counselling (BPTM)	Cardiology		partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		no
Annabathula, R. Dugan, A. Bhalla, V. Davis, G. A. Smyth, S. S. Gupta, V. A.	2020	Value-based assessment of implementing a Pulmonary Embolism Response Team (PERT)	US	US; Kentucky		634 patients, 18 or over, acute Pulmonary Embolism	Cardiology, pulmonary embolism	Cardiology		unspecified	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	total reimbursements	no
Goretti, G. Marinari, G. M. Vanni, E. Ferrari, C.	2020	Value-Based Healthcare and Enhanced Recovery After Surgery Implementation in a High-Volume Bariatric Center in Italy	Italy	Italy		2122 patients, morbidly obese, bariatric surgery	Obesity, surgical, bariatric surgery, Morbid Obesity	Surgical	Bariatric	unspecified	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	Paper only		no
Konda, S. R. Lott, A. Egol, K. A.	2020	Development of a Value-based Algorithm for Inpatient Triage of Elderly Hip Fracture Patients	US	US; New York		361 operative hip fracture patients	Geriatrics, trauma, hip fracture	Surgical	Orthopedic fracture	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Ennis, R. D. Parikh, A. B. Sanderson, M. Liu, M. Isola, L.	2019	Interpreting oncology care model data to drive value-based care: A prostate cancer analysis	US	US; New York		210 patients, 377 episodes of care	Oncology, Hematology, prostate cancer	Oncology		full care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Denneny, J. C. Cyr, D. D. Witsell, D. L. Brereton, J. Schulz, K.	2019	A pathway to value-based care of chronic rhinosinusitis using a claims database	US	US; Maryland		7499183 patients, 18-64, acute rhinosinutitis	Rhinosinusitis, Typical chronic rhinosinusitis	Surgical	ENT	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	claims	no
Peele, P. Keyser, D. Lovelace, J. Moss, D.	2018	Advancing Value-Based Population Health Management Through Payer-Provider Partnerships: Improving Outcomes for Children with Complex Conditions	US	US; Pennsylvania		262 child patients, under 21,	Pediatrics, complex conditions	Pediatrics	Pediatric other	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Brown, M. M. Brown, G. C. Brown, H. C. Peet, J.	2008	A Value-Based Medicine Analysis of Ranibizumab for the Treatment of Subfoveal Neovascular Macular Degeneration	US	US; Pennsylvania		716 patients, classic or neovascular macular degeneration	Neovascular, macular degeneration, Subfoveal Neovascular Macular Degeneration	opthalmology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Burnhope, E. Waring, M. Guilder, A. Malhotra, B. Cardoso, J. M. Razavi, R. Cave-White, G.	2020	A systematic approach towards implementing value-based health care in heart failure: Understandings from retrospective analysis methods in South London	UK	UK; London		134 patients undergoing Implantable Cardioverter Defibrillator (ICD) or Cardiac Resynchronization	Cardiology, heart failure	Surgical	Cardiac/Thoracic	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		yes see second sheet
Khullar, O. V. Jiang, R. Force, S. D. Pickens, A. Sancheti, M. S. Ward, K. Gillespie, T.	2015	Transthoracic versus transhiatal resection for esophageal adenocarcinoma of the lower esophagus: A value-based comparison	US	US; Georgia		942 patients esophagectomy	Oncology, esophageal cancer	Oncology		full care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	Medicare costs, reimbursements	no
Ebinger, J. E. Strauss, C. E. Garberich, R. R. Bradley, S. M. Rush, P. Chavez, I. J. Poulose, A. K.	2018	Value-based ST-segment-elevation myocardial infarction care using risk-guided triage and early discharge	US	US; Minnesota		967 patients receiving primary percutaneous coronary intervention between 2009 and 2011	Cardiology, heart failure, myocardial infarction	Surgical	Cardiac/Thoracic	full care path (surgical episode)	Direct	provider	provider	unspecified; Hospital accounting data not otherwise specified	Unspecified	implemented		no
Bodar, Y. J. L. Srinivasan, A. K. Shah, A. S. Kawal, T. Shukla, A. R.	2020	Time-Driven activity-based costing identifies opportunities for process efficiency and cost optimization for robot-assisted laparoscopic pyeloplasty	US	US; Pennsylvania	single center, retrospective, direct observation	25 robot assisted laparoscopic pyeloplasties	Pediatrics, urology, robotics, robot	Pediatrics	Pediatric surgical	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Verberne, W. R. Dijkers, J. Kelder, J. C. Geers, A. B. M. Jellema, W. T. Vincent, H. H. Van Delden, J. J. M.	2018	Value-based evaluation of dialysis versus conservative care in older patients with advanced chronic kidney disease: A cohort study	The Netherlands	The Netherlands		366 patients aged ≥70 years with advanced chronic kidney disease	Nephrology, kidney, dialysis, chronic	Nephrology		full care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no

Gregory, D. Scotti, D. J. de Lissovoy, G. Palacios, I. Dixon, S. Maini, B. O'Neill, W.	2013	A value-based analysis of hemodynamic support strategies for high-risk heart failure patients undergoing a percutaneous coronary intervention	US	US; various states		427 patients enrolled in trial, mean age 68, 80.6% male	Cardiology, heart failure	Surgical	Cardiac/Thoracic	partial care path	Direct and indirect	provider (proxy)	payer		none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy		N/A	none, charges, cost to charges	no
Ravikumar, T. S. Sharma, C. Marini, C. Steele, G. D. Ritter, G. Barrera, R. Kim, M.	2010	A validated value-based model to improve hospital-wide perioperative outcomes: Adaptability to combined medical/surgical inpatient cohorts	US	US; New York		>100,000 hospital admissions	Surgical	Surgical	other	partial care path	Direct	provider	provider		direct variable costs as an estimation of total costs	Direct costing		Paper only		no
Ning, M. S. Venkatesan, A. M. Stafford, R. J. Bui, T. P. Carlson, R. Baillard, N. S. Madam, S.	2020	Developing an intraoperative 3T MRI-guided brachytherapy program within a diagnostic imaging suite: Methods, process workflow, and value-based analysis	US	US; Texas	single center, retrospective, direct observation, process mapping	10 female patients	Oncology, Gynecology, gynecologic pelvic tumor	Oncology		full care path (surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
Sun, L. L. Cao, D. Y. Yang, J. X. Bian, M. L. Wei, L. H. Shen, K.	2012	Value-based medicine analysis on loop electrosurgical excision procedure and CO2 laser vaporization for the treatment of cervical intraepithelial neoplasia 2	China	China		338 female patients, 18-65, colposcopic-histopathologically confirmed CIN2, intact uterus, no past history of cervical neoplasia, and had a	Obstetrics, Gynecology, cervical neoplasia	gynecology & obstetrics		partial care path	unspecified	provider	provider		unspecified	Unspecified		unspecified		no
Fortmann, A. L. Walker, C. Barger, K. Robacker, M. Morrisey, R. Ortwine, K. Lopez, J.	2020	Care Team Integration in Primary Care Improves One-Year Clinical and Financial Outcomes in Diabetes: A Case for Value-Based Care	US	US; California		236 treated patients, 239 usual care patients. All diagnosed with type 1 or 2 diabetes.	Diabetes	Internal Medicine		partial care path	Direct	provider	provider		direct variable costs as an estimation of total costs	Direct costing		implemented		no
Ramirez, M. M. Brennan, G. P.	2020	Using the value-based care paradigm to compare physical therapy access to care models in cervical spine radiculopathy: a case report	US	US; Florida		case study; 39 yo female	Physiotherapy	Neurology		partial care path	Direct and indirect	payer, patient	payer	patient	none, reimbursements	Charges/Reimbursement-based	Charges/Reimbursement-based patient OoO	N/A	cost to patient, reimbursement	no
Ryan, S. P. Plate, J. F. Black, C. S. Howell, C. B. Jiranek, W. A. Bolognesi, M. P. Seyler, T. M.	2019	Value-Based Care Has Not Resulted in Biased Patient Selection: Analysis of a Single Center's Experience in the Care for Joint Replacement Bundle	US	US; North Carolina		1248 total knee arthroplasty patients,	orthopedics, joint replacement, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	full care path	Direct	provider	provider		direct variable costs as an estimation of total costs	Direct costing		implemented		no
Plate, J. F. Ryan, S. P. Black, C. S. Howell, C. B. Jiranek, W. A. Bolognesi, M. P. Seyler, T. M.	2019	No Changes in Patient Selection and Value-Based Metrics for Total Hip Arthroplasty After Comprehensive Care for Joint Replacement Bundle Implementation at a Single Center	US	US; North Carolina		751 total hip arthroplasty patients,	orthopedics, joint replacement, total hip arthroplasty	Surgical	Orthopedic, arthroplasty	full care path	Direct	provider	provider		direct variable costs as an estimation of total costs	Direct costing		implemented		no
Abbott, M. M. Meara, J. G.	2011	A microcosting approach for isolated, unilateral cleft lip care in the first year of life	US	US; Massachusetts	single center, retrospective	12 children, cleft lip repair	Pediatrics, cleft palate, plastic surgery	Pediatrics	Pediatric Plastic surgery	partial care path (full surgical episode)	Direct and indirect	provider	provider		Microcosting	Absorption costing - ABC		Paper only		yes see second sheet
Regan, D. K. Manoli, A. Hutzler, L. Konda, S. R. Egol, K. A.	2015	Impact of Diabetes Mellitus on Surgical Quality Measures After Ankle Fracture Surgery: Implications for "Value-Based" Compensation and "Pay for Performance"	US	US; New York		58,748 patients, 7501 with Diabetes Mellitus	Diabetes	Internal Medicine		unspecified	Direct and indirect	payer	payer		none, reimbursements	Charges/Reimbursement-based		N/A	mean total hospital charges	no
Yu, Y. R. Abbas, P. I. Smith, C. M. Carberry, K. E. Ren, H. Patel, B. Nightingale, J. G.	2017	Time-driven activity-based costing: A dynamic value assessment model in pediatric appendicitis	US	US; Texas	single center, retrospective, direct observation, process mapping	207 patients total, 6 phases of care	Pediatrics, appendicitis, simple appendicitis	Pediatrics	Pediatric appendicitis	full care path (surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
Rice-Townsend, S. Barnes, J. N. Hall, M. Baxter, J. L. Rangel, S. J.	2014	Variation in practice and resource utilization associated with the diagnosis and management of appendicitis at freestanding children's hospitals: Implications for value-based comparative analysis	US	US; Massachusetts		13,328 patients, 34 children's hospitals, 25 states in US, acute appendicitis, age 3-18	Pediatrics, appendicitis	Pediatrics	Pediatric appendicitis	unspecified	Direct and indirect	payer	payer		none, reimbursements	Charges/Reimbursement-based		N/A	charges transformed with cost-to-charge ratio	no
Ahluwalia, R. Cook, J. Raheman, F. Karuppaiah, K. Colegate-Stone, T. Tavakkolizadeh, A. Kaneriya, M.	2020	Improving the efficiency of ankle fracture care through home care and day-surgery units: Delivering safe surgery on a value-based healthcare model	UK	UK; London	single center, prospective, process mapping	53 trauma patients	trauma, orthopedics, surgical, ankle fracture	Surgical	Orthopedic fracture	full care path (surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
Basto, J. Chahal, R., Riedel, B.	2019	Time-driven activity-based costing to model the utility of parallel induction redesign in high-turnover operating lists	Australia	Australia	single center, prospective, process mapping	19 all-day surgery lists, patients unspecified	melanoma, oncology	Oncology		partial care path (partial surgical episode)	Direct and indirect	provider	provider		TDABC	Absorption costing - TDABC		Paper only		yes see second sheet

Kadakia, R. J., Ahearn, B.M., Tenenbaum, S., Bariteau, J.T.	2017	Costs Associated With Geriatric Ankle Fractures, Operative Versus Nonoperative Management	US	US; Georgia		19648 ankle fracture patients	trauma, orthopedics, geriatrics, ankle fracture	Surgical	Orthopedic fracture	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based		N/A	medicare reimbursements	no
Barkley, R. Soobader, M. J. Wang, J. Blau, S. Page, R. D.	2019	Reducing Cancer Costs Through Symptom Management and Triage Pathways	US	US; Florida		10417 ER Events, 1879 unique patients	Emergency care, Acute care, Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based		N/A	medicare claims	no
McLaughlin, N. Martin, N. A. Upadhyaya, P. Bari, A. A. Buxey, F. Wang, M. B. Heaney, A. P.	2014	Assessing the cost of contemporary pituitary care	US	US; California	single center, retrospective	27 neurosurgical patients	Neurosurgical, pituitary adenoma	Surgical	Neurosurgery	partial care path (full surgical episode)	Direct and indirect	provider	provider	ABC	Absorption costing - ABC		implemented		yes see second sheet
Hersh, E. H. Yaeger, K. A. Neifert, S. N. Kim, J. Dangayach, N. S. Weiss, N.	2019	Patterns of Health Care Costs Due to External Ventricular Drain Infections	US	US; New York		External ventricular drain (EVD) infection patients	Neurosurgery	Surgical	Neurosurgery	partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic		implemented		no
Meara, J. G. Hughes, C. D. Sanchez, K. Catallozzi, L. Clark, R. Kummer, A. W.	2020	Optimal Outcomes Reporting (OOR): A New Value–Based Metric for Outcome Reporting Following Cleft Palate Repair	US	US; Massachusetts	Retrospective, single-center cohort analysis	94 patients were identified who underwent primary cleft palate repair by the same surgeon	Cleft palate, Palatoplasty, plastic surgery	Surgical	Plastic surgery	full care path	Direct and indirect	provider	provider	Relative Value Units	Absorption costing - unspecified/generic		Paper only		no
Jakovljevic, M. Zugic, A. Rankovic, A. Dagovic, A.	2015	Radiation therapy remains the key cost driver of oncology inpatient treatment	Serbia	Serbia		2544 complex oncology patients	Oncology	Oncology		partial care path	Direct	provider	provider	Microcosting direct costs only	Direct costing		unspecified		no
Suidan, R. S. He, W. Sun, C. C. Zhao, H. Rauh-Hain, J. A. Fleming, N. D. Lu, K. H.	2019	Total and out-of-pocket costs of different primary management strategies in ovarian cancer	US	US; Texas		12761 patients	Gynecology, oncology, ovarian cancer	gynecology & obstetrics		unspecified	Direct and indirect	Payer, patient	payer	patient	none, reimbursements	Charges/Reimbursement-based	Charges/Reimbursement-based patient OoO	N/A	charges	no
Lenfant, L. Sawczyn, G. Kim, S. Aminsharifi, A. Kaouk, J.	2020	Single-institution Cost Comparison: Single-port Versus Multiport Robotic Prostatectomy	US	US; Ohio	Retrospective, single-center cohort	175 patients	Oncology, prostate cancer, surgical	Oncology		partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic		unspecified		yes see second sheet
Hemmila, M. R. Cain-Nielsen, A. H. Wahl, W. L. Vander Kolk, W. E. Jakubus, J. L. Mikhail, J. N. Rickmeyer, N. J.	2014	Regional collaborative quality improvement for trauma reduces complications and costs	US	US; Texas		72084 episodes of acute trauma care	Acute care	emergency care & acute care		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based		N/A	price-standardized payments, claims, DRG prices	no
AlAshqar, A. Goktepe, M. E. Kilic, G. S. Borahay, M. A.	2021	Predictors of the cost of hysterectomy for benign indications	US	US; Maryland		1847 female hysterectomy patients	gynecology, obstetrics, Vaginal hysterectomy	gynecology & obstetrics		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based		N/A	charges	no
Naghavi, A. O. Gonzalez, R. J. Scott, J. G. Kim, Y. Abuodeh, Y. A. Strom, T. J. Echevarria, M.	2017	Staged reconstruction brachytherapy has lower overall cost in recurrent soft-tissue sarcoma	US	US; Florida		22 soft-tissue sarcoma patients	Oncology, soft-tissue sarcoma	Oncology		full care path	unspecified	payer	payer	none; charges	Charges/Reimbursement-based		N/A	charges	no
Puvanesarajah, V. Kirby, D. J. Jain, A. Werner, B. C. Hassanzadeh, H.	2017	Cost Variation of Anterior Cervical Fusions in Elderly Medicare Beneficiaries	US	US; unspecified		21,853 patients	orthopedics, geriatrics, elective anterior cervical fusions	Surgical	Orthopedic fracture	unspecified	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based		N/A	reimbursements	no
Siu, A. Patel, J. Prentice, H. A. Cappuzzo, J. M. Hashemi, H. Mukherjee, D.	2017	A Cost Analysis of Regional Versus General Anesthesia for Carotid Endarterectomy	US	US; Virginia		346 patients	Neurosurgery, anasthesia, carotid endarterectomy	Surgical	Neurosurgery	unspecified	direct	provider	provider	unspecified	Direct costing		implemented		no
Kirsch, D. B. Yang, H. Maslow, A. L. Stolzenbach, M. McCall, A.	2019	Association of Positive Airway Pressure Use With Acute Care Utilization and Costs	US	US; North Carolina		1098 patients	Sleep medicine, sleep apnea, Obstructive Sleep Apnea	Internal Medicine		partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic		implemented		no

Passias, P. G. Poorman, G. W. Bortz, C. A. Qureshi, R. Diebo, B. G. Paul, J. C. Horn, S. R.	2018	Predictors of adverse discharge disposition in adult spinal deformity and associated costs	US	US; New York		2408 patients	orthopedic, surgical	Surgical	Spine	partial care path	unspecified	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Monroe, G. R. Frederix, G. W. Savelberg, S. M. C. De Vries, T. I. Duran, K. J. Van Der Smagt, J. J. Terhal, P. A.	2016	Effectiveness of whole-exome sequencing and costs of the traditional diagnostic trajectory in children with intellectual disability	The Netherlands	The Netherlands		17 patients	Genetics, Pediatrics, Intellectual disability	Pediatrics	Pediatric other	full care path	Direct	provider	provider	bottom-up clinical costing approach	Direct costing	implemented		no
Manrriquez, E. Mandelbaum, A. Aguayo, E. Zakhour, M. Karlan, B. Benharash, P. Cohen, J. G.	2020	Factors associated with high-cost hospitalizations in elderly ovarian cancer patients	US	US; Virginia		21853 patients	Geriatrics, oncology, ovarian cancer, anterior cervical discectomy and fusion, anterior cervical fusion, cervical spine, cervical spondylosis	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursement	no
Wise, K. Blaschke, B. L. Parikh, H. R. Gorman, T. Casnovsky, L. McMilan, L. J. Thornhill, J.	2020	Variation of the Inpatient Cost of Care in the Treatment of Isolated Geriatric Intertrochanteric Hip Fractures	US	US; Minnesota	single center, retrospective	287 patients	orthopedics, geriatrics, hip fracture, surgical	Surgical	Orthopedic fracture	partial care path (full surgical episode)	Direct and indirect	provider	provider	ABC	Absorption costing - ABC	implemented		yes see second sheet
Rocque, G. B. Williams, C. P. Jackson, B. E. Ingram, S. A. Halilova, K. I. Pisu, M. Kenzik, K. M.	2018	Resource Use and Medicare Costs During Lay Navigation for Geriatric Patients With Cancer	US	US; Alabama		988 patients	Geriatrics, oncology, De Novo Metastatic Breast Cancer	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursement	no
Schwartz, D. A. Shah, A. A. Zogg, C. K. Nicholas, L. H. Velopulos, C. G. Efron, D. T. Schneider, E. B.	2015	Operative delay to laparoscopic cholecystectomy: Racking up the cost of health care	US	US; Massachusetts		191032 patient records	Surgical, acute care, acute cholecystitis, aparoscopic cholecystectomy	Surgical	Gallbladder	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Brixner, D. Rubin, D. T. Mease, P. Mittal, M. Liu, H. Davis, M. Gascoyne, A.	2019	Patient support program increased medication adherence with lower total health care costs despite increased drug spending	US	US; various states		1134 patients	Multiple	multiple		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Aguayo, E. Sanaiha, Y. Seo, Y. J. Mardock, A. Bailey, K. Dobaria, V. Benharash, P.	2018	Heparin-induced thrombocytopenia in cardiac surgery: Incidence, costs, and duration of stay	US	US; California		13943 patients	Cardiology, surgical, thrombocytopenia, Heparin-induced thrombocytopenia	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	payer	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Cronin, K. J. Mair, S. D. Hawk, G. S. Thompson, K. L. Hettrich, C. M. Jacobs, C. A.	2020	Increased Health Care Costs and Opioid Use in Patients with Anxiety and Depression Undergoing Rotator Cuff Repair	US	US; Kentucky		170329 patients	orthopedic, surgical, depression, Rotator Cuff Repair	Surgical	Orthopedic rotator cuff repair	partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Alli, V. V. Zhang, J. Telem, D. A.	2018	Impact of incisional hernia development following abdominal operations on total healthcare cost	US	US; Texas		14290 patients	Surgical, hernia, Incisional hernia	Surgical	Abdominal	full care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Robles, A. J. Kornblith, L. Z. Hendrickson, C. M. Howard, B. M. Conroy, A. S. Moazed, F. Calfee, C. S.	2018	Health care utilization and the cost of posttraumatic acute respiratory distress syndrome care	US	US; California		1552 patients	Acute care, trauma care	emergency care & acute care		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
van Dijck, J. T. J. M. van Essen, T. A. Dijkman, M. D. Mostert, C. Q. B. Polinder, S. Peul, W. C. de Ruiter, G. C. W.	2019	Functional and patient-reported outcome versus in-hospital costs after traumatic acute subdural hematoma (t-ASDH): a neurosurgical paradox?	The Netherlands	The Netherlands		108 patients	Acute care, brain injury, acute subdural hematoma, trauma care	emergency care & acute care		partial care path	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic	Paper only		no
Thakore, R. V. Greenberg, S. E. Shi, H. Foxx, A. M. Francois, E. L. Prablek, M. A. Akuoma, S. K.	2015	Surgical site infection in orthopedic trauma: A case-control study evaluating risk factors and cost	US	US; Tennessee		78 patients	orthopedic, surgical	Surgical	Orthopedic	unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Smith, B. D. Jiang, J. Shih, Y. C. Giordano, S. H. Huo, J. Jagsi, R. Momoh, A. O.	2017	Cost and complications of local therapies for early-stage breast cancer	US	US; Texas		105 211 female patients	Oncology, breast cancer	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no

Lentz, T. A. Rhon, D. I. George, S. Z.	2020	Predicting Opioid Use, Increased Health Care Utilization and High Costs for Musculoskeletal Pain: What Factors Mediate Pain Intensity and Disability?	US	US; Washington		283 patients	Pain, Musculoskeletal Pain	Pain medicine		partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		no
Kaul, S. Korgenski, E. K. Ying, J. Ng, C. F. Smits-Seemann, R. R. Nelson, R. E. Andrews, S.	2016	A retrospective analysis of treatment- related hospitalization costs of pediatric, adolescent, and young adult acute lymphoblastic leukemia	US	US; Utah	single center, retrospective	505 patients	Oncology, leukemia, acute lymphoblastic leukemia	Pediatrics	Pediatric Oncology	partial care path	Direct and indirect	provider	provider	ABC	Absorption costing - ABC	implemented		no
Silva-Velazco, J. Dietz, D. W. Stocchi, L. Costedio, M. Gorgun, E. Kalady, M. F. Kessler, H.	2017	Considering Value in Rectal Cancer Surgery: An Analysis of Costs and Outcomes Based on the Open, Laparoscopic, and Robotic Approach for Proctectomy	US	US; Ohio		488 patients	Oncology, rectal cancer	Oncology		partial care path (surgical episode)	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		no
Canizares, M. F. Feldman, L. Miller, P. E. Waters, P. M. Bae, D. S.	2017	Complications and Cost of Syndactyly Reconstruction in the United States: Analysis of the Pediatric Health Information System	US	US; Massachusetts		38 hospitals, 2047 procedures	Pediatrics, orthopedic, surgical, Syndactyly Reconstruction	Pediatrics	Pediatric surgical	partial care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Vuong, B Dehal, A Uppal, A Stern, S L Mejia, J Weerasinghe, R Kapoor, V	2018	What Are the Most Significant Cost and Value Drivers for Pancreatic Resection in an Integrated Healthcare System?	US	US; California		796 patients	Surgical, Pancreas, Pancreatic Resection	Surgical	Endocrine	partial care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	unspecified		no
Sanaiha, Y. Mantha, A. Ziacian, B. Juo, Y. Y. Shemin, R. J. Benharash, P.	2020	Trends in Readmission and Costs After Transcatheter Implantation Versus Surgical Aortic Valve Replacement in Patients With Renal Dysfunction	US	US; LA		350,609 isolated aortic valve replacements	Cardiology, Renal, Aortic Repair, Thoracic Endovascular Aortic Repair	Surgical	Cardiac/Thoracic	partial care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Chatfield, S. C. Volpicelli, F. M. Adler, N. M. Kim, K. L. Jones, S. A. Francois, F. Shah, R. C.	2019	Bending the cost curve: time series analysis of a value transformation programme at an academic medical centre	US	US; New York	single center, retrospective	74 projects, 160434 patients,	Multiple	multiple		partial care path	Direct	provider	provider	ABC	Direct costing	implemented		yes see second sheet
Chawla, S. S. Whitson, A. J. Schiffman, C. J. Matsen, F. A. Hsu, J. E.	2020	Drivers of lower inpatient hospital costs and greater improvements in health-related quality of life for patients undergoing total shoulder and ream-and-run arthroplasty	US	US; Washington		433 patients	orthopedics, athroplasty, total shoulder and ream-and-run arthroplasty	Surgical	Orthopedic, arthroplasty	unspecified	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Klink, A. J. Chmielowski, B. Feinberg, B. Ahsan, S. Nero, D. Liu, F. X.	2019	Health Care Resource Utilization and Costs in First-Line Treatments for Patients with Metastatic Melanoma in the United States	US	US; various states		1599 patients	Oncology, melanoma	Oncology		unspecified	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	claims	no
Chotai, S. Sivaganesan, A. Parker, S. L. Sielatycki, J. A. McGirt, M. J. Devin, C. J.	2018	Drivers of Variability in 90-Day Cost for Elective Anterior Cervical Discectomy and Fusion for Cervical Degenerative Disease	US	US; Tennessee		445 patients	Spine, cervical degenerative disease	Surgical	Spine	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Sanaiha, Y. Kavianpour, B. Downey, P. Morchi, R. Shemin, R. J. Benharash, P.	2020	National Study of Index and Readmission Mortality and Costs for Thoracic Endovascular Aortic Repair in Patients With Renal Disease	US	US; California		121046 patients	Cardiology, Surgical, Aortic repair, Renal Disease	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Jain, N. Brock, J. L. Phillips, F. M. Weaver, T. Khan, S. N.	2018	Chronic preoperative opioid use is a risk factor for increased complications, resource use, and costs after cervical fusion	US	US; various states		29101 patients	Spine, cervical degenerative disease	Surgical	Spine	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Featherall, J. Brigati, D. P. Arney, A. N. Faour, M. Bokar, D. V. Murray, T. G. Molloy, R. M.	2019	Effects of a Total Knee Arthroplasty Care Pathway on Cost, Quality, and Patient Experience: Toward Measuring the Triple Aim	US	US; Ohio		6760 surgeries	orthopedics, total knee athroplasty	Surgical	Orthopedic, arthroplasty	full care path (surgical episode)	Direct	provider	provider	Relative Value Unit costing	Direct costing	implemented		yes see second sheet
Ackerman, R. S. Hirschi, M. Alford, B. Evans, T. Kiluk, J. V. Patel, S. Y.	2019	Enhanced REVENUE After Surgery? A Cost-Standardized Enhanced Recovery Pathway for Mastectomy Decreases Length of Stay	US	US; unspecified		103 patients	Oncology, mastectomy	Oncology		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no

Williams, S. B. Shan, Y. Jazzar, U. Mehta, H. B. Baillargeon, J. G. Huo, J. Sonagore, A. J.	2018	Comparing Survival Outcomes and Costs Associated With Radical Cystectomy and Trimodal Therapy for Older Adults With Muscle-Invasive Bladder Cancer	US	US; various states	3200 patients	Oncology, urology, surgical, bladder cancer	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Schilling, P. L. He, J. Chen, S. Placzek, H. Bini, S. A.	2020	Risk-Adjusted Cost Performance for 90-Day Total Hip Arthroplasty Episodes: Comparing US Hospitals Nationwide Before CJR	US	US; various states	366380 patients	Surgical	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Lott, A. Haglin, J. Saleh, H. Hall, J. Egol, K. A. Konda, S. R.	2018	Using a Validated Middle-Age and Geriatric Risk Tool to Identify Early (48 Hours) Hospital Mortality and Associated Cost of Care	US	US; various states	1486 patients	Acute care, geriatrics, Emergency care	emergency care & acute care		partial care path	Direct	provider	provider	unspecified; Hospital accounting data not otherwise specified	Direct costing	implemented		no
Ackerman, S. J. Knight, T. Wahl, P. M. Cartwright, C. P.	2019	Health care utilization and costs following amplified versus non-amplified molecular probe testing for symptomatic patients with suspected vulvovaginitis: A us commercial payer population	US	US; various states	313145 patients	Gynecology, obstetrics, vulvocvaginitis	gynecology & obstetrics		unspecified	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Peard, L. Goodwin, J. Hensley, P. Dugan, A. Bylund, J. Harris, A. M.	2019	Examining and Understanding Value: The Impact of Preoperative Characteristics, Intraoperative Variables, and Postoperative Complications on Cost of Robot-Assisted Laparoscopic Radical Prostatectomy	US	US; Kentucky	275 patients	Surgical, robot, Robot-Assisted Laparoscopic Radical Prostatectomy	Surgical	Prostatectomy	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Patel, M. I. Ramirez, D. Agajanian, R. Agajanian, H. Bhattacharya, J. Bundorf, K. M.	2020	Lay health worker-led cancer symptom screening intervention and the effect on patient-reported satisfaction, health status, health care use, and total costs: Results from a tri-part collaboration	US	US; California	425 enrollees	Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Harris, A. M. Hensley, P. Goodwin, J. Dugan, A. Peard, L. Bell, J. R. Bhaladi, A.	2019	Examining and Understanding Value: The Cost of Preoperative Characteristics, Intraoperative Variables and Postoperative Complications of Minimally Invasive Partial Nephrectomy	US	US; Kentucky	215 patients	Urology, surgical, Nephrectomy	Surgical	kidney	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Stearns, L. J. Narang, S. Albright, R. E. Hammond, K. Xia, Y. Richter, H. B. Ramamoorthy, G. K.	2019	Assessment of Health Care Utilization and Cost of Targeted Drug Delivery and Conventional Medical Management vs Conventional Medical Management Alone for Patients With Cancer-Related Pain	US	US; various states	5215 patients	Oncology, Pain, pain management	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
McCreary, D. L. Dugarte, A. J. Vang, S. Plowman, B. Williams, B. R. Parikh, H. R. Cunningham, B. B.	2019	Patient-Level Value Analysis: An Innovative Approach to Optimize Care Delivery	US	US; Minnesota	single center, prospective, process mapping 67 patients	orthopedics	Surgical	Orthopedic fracture	partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Caloway, C. Yamasaki, A. Callans, K. M. Shah, M. Kaplan, R. S. Hartnick, C.	2020	Quantifying the benefits from a care coordination program for tracheostomy placement in neonates	US	US; Massachusetts	single center, retrospective, direct observation, pre and post comparison 10 patients	Neonatal, pediatrics, tracheostomy, surgical	Pediatrics	Pediatric Neonatal	partial care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Navarro, S. M. Wang, E. Y. Haeberle, H. S. Mont, M. A. Krebs, V. E. Patterson, B. M. Ramkumar, P. N.	2018	Machine Learning and Primary Total Knee Arthroplasty: Patient Forecasting for a Patient-Specific Payment Model	US	US; New York	141446 patients	orthopedics, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	partial care path (surgical episode)	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Skill, N. J. Butler, J. O'Brien, D. C. Kays, J. K. Kubal, C. Liangpunsakul, S. Sinogeiya, M.	2019	Financial Burden of Liver Transplant vs Resection for Hepatocellular Carcinoma	US	US; Indiana	44 patients	Oncology, renal	Oncology		partial care path	Direct and indirect	provider (proxy)	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Robinson, Jamie R. Avritscher, Elenir B.C. Gay, James C. Willis, Zachary I. Putnam, Luke R. Anglemyer, Andrew Bulger, Claudia	2017	Measuring the Value of a Clinical Practice Guideline for Children With Perforated Appendicitis	US	US; Tennessee	313 patients	Appendicitis, Pediatrics	Pediatrics	Pediatric appendicitis	partial care path (surgical episode)	Direct and indirect	provider, payer	provider	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	Absorption costing - unspecified/generic	N/A	charges	no
Labovitz, J. M. Kominski, G. F.	2016	Forecasting the Value of Podiatric Medical Care in Newly Insured Diabetic Patients During Implementation of the Affordable Care Act in California	US	US; California	unspecified	Diabetes	Internal Medicine		unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no

Johnson, J. T. Scholtens, D. M. Kuang, A. Feng, X. Y. Eltayeb, O. M. Post, L. A. Marino, B. S.	2020	Does value vary by center surgical volume for neonates with truncus arteriosus? A multicenter study	US	US; various states	1024 neonates	Neonatal, pediatrics, surgical, cardiology, thoracic surgery	Pediatrics	Pediatric Neonatal	full care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Karnuta, J. M. Navarro, S. M. Haeberle, H. S. Helm, J. M. Kamath, A. F. Schaffer, J. L. Krebs, V. E.	2019	Predicting Inpatient Payments Prior to Lower Extremity Arthroplasty Using Deep Learning: Which Model Architecture Is Best?	US	US; New York	295605 patients	orthopedics, total hip arthroplasty, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	payment, cost to payor	no
Saifi, C. Cazzulino, A. Park, C. Laratta, J. Louie, P. K. Shillingford, J. N. Lehman, R.	2018	National Trends for Primary and Revision Lumbar Disc Arthroplasty Throughout the United States	US	US; various states	12957 patients	Athroplasty	Surgical	Orthopedic, arthroplasty	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Ning, M. S. Palmer, M. B. Shah, A. K. Chambers, L. C. Garlock, L. B. Melson, B. B. Kwak, G. J.	2020	Three-year results of a prospective statewide insurance coverage pilot for proton therapy: Stakeholder collaboration improves patient access to care	US	US; Texas	32 patients	Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Mukdad, L. Mantha, A. Aguayo, E. Sanaiha, Y. Juo, Y. Y. Ziaeian, B. Shemin, R. J.	2018	Readmission and resource utilization after orthotopic heart transplant versus ventricular assist device in the National Readmissions Database, 2010–2014	US	US; California	12111 patients	Thoracic surgery, Cardiology, heart failure, heart transplant, VADs	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Frankel, W. C. Navarro, S. M. Haeberle, H. S. Ramanathan, D. Ramkumar, P. N.	2019	Optimizing the Volume-Value Relationship in Laminectomy: An Evidence-Based Analysis of Outcomes and Economies of Scale	US	US; New York	67758 patients	orthopedic, laminectomy, surgical	Surgical	Spine	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Boucek, D. M. Lal, A. K. Eckhauser, A. W. Weng, H. Y. C. Sheng, X. Wilkes, J. F. Pinto, N. M.	2018	Resource Utilization for Initial Hospitalization in Pediatric Heart Transplantation in the United States	US	US; Pennsylvania	1629 patients	Pediatrics, cardiology	Pediatrics	Pediatric surgical	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Keller, D. S. Zhang, J. Chand, M.	2019	Opioid-free colorectal surgery: a method to improve patient & financial outcomes in surgery	US	US; various states	50098 cases	Surgical, Laparoscopic colorectal surgery	Surgical	Colon/Rectal	unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Reilly, R. F.	2020	Creating a Value Dashboard for orthopedic Surgical Procedures	Lebanon	Lebanon	6 surgeons' data	Orthopeadics, total knee arthroplasty, total hip arthroplasty	Surgical	Orthopedic, arthroplasty	unspecified	Direct	provider	provider	unspecified; Hospital accounting data not otherwise specified	Direct costing	implemented		no
Miller, P. E. Guha, A. Khera, R. Chouairi, F. Ahmad, T. Nasir, K. Addison, D.	2019	National Trends in Healthcare-Associated Infections for Five Common Cardiovascular Conditions	US	US; various states	17889852 hospitalizations	Cardiology, cardiovascular	Cardiology		unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Konda, Sanjit R. Lott, Ariana Egol, Kenneth A.	2018	The coming hip and femur fracture bundle: A new inpatient risk stratification tool for care providers	US	US; New York	173 patients	Orthopeadics, Geriatrics, total hip arthroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct	provider	provider	unspecified; Hospital accounting data not otherwise specified	Direct costing	implemented		no
Winegar, A. L. Jackson, L. W. Sambare, T. D. Liu, T. C. Banks, S. R. Erlinger, T. P. Schultz, W. B.	2019	A Surgeon Scorecard Is Associated with Improved Value in Elective Primary Hip and Knee Arthroplasty	US	US; Texas	470 patients	Surgical, total hip arthroplasty, knee arthroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
Rocque, G. B. Williams, C. P. Kenzik, K. M. Jackson, B. E. Halilova, K. I. Sullivan, M. M. Roussos, P. P.	2017	Where Are the Opportunities for Reducing Health Care Spending Within Alternative Payment Models?	US	US; Alabama	3427 patients from 12 cancer centers	Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Laratta, J. L. Reddy, H. Lombardi, J. M. Shillingford, J. N. Saifi, C. Fischer, C. R. Lehman, R. A.	2018	Utilization of Interspinous Devices Throughout the United States Over a Recent Decade: An Analysis of the Nationwide Inpatient Sample	US	US; various states	14225 patients	Surgical, spine	Surgical	Spine	partial care path (surgical episode)	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Karnuta, J. M. Golubovsky, J. L. Haeberle, H. S. Rajan, P. V. Navarro, S. M. Kamath, A. F. Schaffer, J. L.	2020	Can a machine learning model accurately predict patient resource utilization following lumbar spinal fusion?	US	US; various states	38070 patients	Spine, lumbar spinal fusion	Surgical	Spine	unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no

Karnuta, J. M. Navarro, S. M. Haeberle, H. S. Billow, D. G. Krebs, V. E. Ramkumar, P. N.	2019	Bundled Care for Hip Fractures: A Machine-Learning Approach to an Untenable Patient-Specific Payment Model	US	US; New York	98562 patients	orthopedics, hip fracture, trauma	Surgical	Orthopedic fracture	partial care path	Direct and indirect	provider (proxy)	payer	none; estimation, cost-to-charge ratio, SPARCS data	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Cremins, M. Vellanky, S. McCann, G. Mancini, M. Sanzari, L. Yannopoulos, A.	2020	Considering healthcare value and associated risk factors with postoperative urinary retention after elective laminectomy	US	US; Conneticut	433 patients	surgical, elective laminectomy	Surgical	Spine	partial care path	Direct	provider	provider	direct costs	Direct costing	unspecified		no
Navarro, S. M. Ramkumar, P. N. Egger, A. C. Goodwin, R. C.	2018	Evidence-Based Thresholds for the Volume-Value Relationship in Adolescent Idiopathic Scoliosis: Outcomes and Economies of Scale	US	US; New York	3224 patients	Orthopoedic, Pediatrics, Adolescent Idiopathic Scoliosis	Pediatrics	Pediatric other	partial care path	Direct and indirect	provider (proxy)	payer	none; estimation, cost-to-charge ratio, SPARCS data	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Bateni, S. B. Gingrich, A. A. Hoch, J. S. Canter, R. J. Bold, R. J.	2019	Defining Value for Pancreatic Surgery in Early-Stage Pancreatic Cancer	US	US; California	2786 patients, 157 hospitals	Oncology, pancreatic cancer	Oncology		unspecified	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Xiao, R. Miller, J. A. Zafirau, W. J. Gorodeski, E. Z. Young, J. B.	2018	Impact of Home Health Care on Health Care Resource Utilization Following Hospital Discharge: A Cohort Study	US	US; unspecified	6363 patients	Multiple	multiple		partial care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
Ramshaw, B. Forman, B. R. Moore, K. Heidel, E. Fabian, M. Mancini, G. Joshi, G. P.	2017	Real-World Clinical Quality Improvement for Complex Abdominal Wall Reconstruction	US	US; Texas	102 patients	Surgical, complex abdominal wall reconstruction	Surgical	Abdominal	full care path (surgical episode)	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	implemented		no
Heincelman, M. Schumann, S. O. Riley, J. Zhang, J. Marsden, J. E. Mauldin, P. D. Pookey, D. C.	2016	Identification of High Utilization Inpatients on Internal Medicine Services	US	US; unspecified	7571 patients	Internal medicine	Internal Medicine		unspecified	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	implemented		no
Sheetz, K. H. Kenney, B. Dupree, J. M. Campbell, D. A. Englesbe, M. J.	2019	Targeting Value-Driven Quality Improvement for Laparoscopic Cholecystectomy in Michigan	US	US; Michigan	19213 patients	Surgical, Laparoscopic Cholecystectomy	Surgical	Gallbladder	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Zolin, S. J. Tastaldi, L. Alkhatib, H. Lampert, E. J. Brown, K. Fafaj, A. Petro, C. C.	2020	Open retromuscular versus laparoscopic ventral hernia repair for medium-sized defects: where is the value?	US	US; various states	All medicare shoulder surgeries 2002-2018	orthopedics, Surgical, Shoulder surgery	Surgical	Abdominal	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Ahluwalia, R. Vainieri, E. Tam, J. Sait, S. Sinha, A. Manu, C. A. Reichert, I.	2019	Surgical Diabetic Foot Debridement: Improving Training and Practice Utilizing the Traffic Light Principle	UK	UK; London	single center, retrospective, direct observation, pre and post comparison	53 patients	Surgical, diabetic foot infection, diabetes	Surgical	Diabetes	partial care path (full surgical episode)	Direct and indirect	payer	payer	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
Ramly, E. P. Larentzakis, A. Bohnen, J. D. Mavros, M. Chang, Y. Lee, J. Yeh, D. D.	2015	The financial impact of intraoperative adverse events in abdominal surgery	US	US; Massachusetts	9111 patients	surgical, abdominal surgery	Surgical	Abdominal	unspecified	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	implemented		no
Orhurhu, V. Urits, I. Olusunmade, M. Owais, K. Jones, M. Galasso, A. Solim Orhurhu, M.	2018	Trends of Co-Morbid Depression in Hospitalized Patients with Failed Back Surgery Syndrome: An Analysis of the Nationwide Inpatient Sample	US	US; unspecified	115976 patients	Surgical, depression, psychiatry	Pain medicine		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A		no
Hollenbeck, B. Hoffman, M. A. Tromanhauser, S. G.	2020	High-Volume Arthroplasty Centers Demonstrate Higher Composite Quality Scores and Enhanced Value: Perspective on Higher-Volume Hospitals Performing Arthroplasty from 2001 to 2011	US	US; various states	1651354 total hip or total knee arthroplasties	orthopedics, surgical, total hip arthroplasty, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	unspecified	Direct and indirect	provider (proxy)	payer	none; charges	Charges/Reimbursement-based	N/A	charges per quartile, discuss how it should be costs in discussion	no
Loftus, T. J. Rosenthal, M. D. Croft, C. A. Stephen Smith, R. Efron, P. A. Moore, F. A. Mohr, A. M.	2018	Effect of Time to Operation on Value of Care in Acute Care Surgery	US	US; Florida	800 patients	Acute care, appendicitis, surgical, laparotomy for intra-abdominal sepsis with temporary abdominal closure	Surgical	Appendicitis	full care path (surgical episode)	unspecified	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges, discuss shortcoming in discussion	no

Buell, J. F. Sigmon, D. Ducoin, C. Shapiro, M. Teja, N. Wynter, E. Hanisee, M. K.	2017	Initial Experience with Biologic Polymer Scaffold (Poly-4-hydroxybuturate) in Complex Abdominal Wall Reconstruction	US	US; Louisiana		73 patients	Surgical, complex abdominal wall reconstruction	Surgical	Abdominal	full care path (surgical episode)	unspecified	payer	payer	none; charges	Charges/Reimbursement-based	N/A		no
Jain, N. Phillips, F. M. Shimer, A. L. Khan, S. N.	2018	Surgeon Reimbursement Relative to Hospital Payments for Spinal Fusion	US	US; various states		40965 patients	Surgical	Surgical	Spine	unspecified	unspecified	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	charges	no
Stull, J. D. Bhat, S. B. Kane, J. M. Raikin, S. M.	2017	Economic Burden of Inpatient Admission of Ankle Fractures	US	US; unspecified		76 cases/patients, and 48044 retrospective patient files	orthopedics, Surgical, ankle fractures	Surgical	Orthopedic fracture	unspecified	unspecified	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursement	no
Lewis, R. B. Hariri, O. Elliott, M. E. Jo, C. H. Ramo, B. A.	2020	Financial Analysis of Closed Femur Fractures in 3- to 6-Year-Olds Treated with Immediate Spica Casting Versus Intramedullary Fixation	US	US; Texas		114 patients	orthopedic, surgical, pediatrics	Pediatrics	Pediatric surgical	full care path	unspecified	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Murphy, W. S. Cheng, T. Lin, B. Terry, D. Murphy, S. B.	2019	Higher Volume Surgeons Have Lower Medicare Payments, Readmissions, and Mortality after THA	US	US; Massachusetts		409,844 cases	orthopedics, total hip athroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Geerdink, T. H. Haverlag, R. van Veen, R. N. Bouwmeester, O. V. A. Goslings, J. C.	2020	Direct discharge from the ED for patients with simple stable injuries: a Dutch pilot study	The Netherlands	The Netherlands		275 patients	Acute care, emergency care	emergency care & acute care		partial care path	direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic	unspecified		no
Martin, J. A. Mayhew, C. R. Morris, A. J. Bader, A. M. Tsai, M. H. Urman, R. D.	2018	Using Time-Driven Activity-Based Costing as a Key Component of the Value Platform: A Pilot Analysis of Colonoscopy, Aortic Valve Replacement and Carpal Tunnel Release Procedures	US	US; Vermont	multi center, retrospective, process mapping, pilot projects (3)	3 pilot studies	Surgical, cardiology, aortic valve replacement	Surgical	Cardiac/Thoracic	partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		yes see second sheet
Abdulla, A. G. Ituarte, P. H. Wiggins, R. Teisberg, E. O. Harari, A. Yeh, M. W.	2012	Endocrine surgery as a model for value-based health care delivery	US	US; California		44631 patients	Surgical, neurological	Surgical	Endocrine	unspecified	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	implemented		no
King, A. M. Danagoulian, S. Lynch, M. Menke, N. Mu, Y. Saul, M. Abaseeva, M.	2019	The Effect of a Medical Toxicology Inpatient Service in an Academic Tertiary Care Referral Center	US	US; Pennsylvania		1675 patient records	Toxicology	toxicology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A		no
van der Meulen, M. Najafabadi, A. H. Z. Lobatto, D. J. van den Hout, W. B. Andela, C. D. Zandbergen, I. M. Pereira, A. M.	2020	Healthcare utilization and costs among prolactinoma patients: a cross-sectional study and analysis of determinants	The Netherlands	The Netherlands		373 patients	Endocrinology, Pituitary adenoma, prolactinoma	endocrinology		full care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	Paper only		no
Edholm, K. Lappe, K. Kukhareva, P. Hopkins, C. Hatton, N. D. Gebhart, B. Nyman, H.	2020	Reducing Diabetic Ketoacidosis Intensive Care Unit Admissions Through an Electronic Health Record-Driven, Standardized Care Pathway	US	US; Utah	single center, retrospective, pre and post intervention	214 hospital admissions	Acute care, emergency care	emergency care & acute care		full care path	Direct	provider	provider	unspecified; Hospital accounting data, value based outcomes toolk	Direct costing	implemented		no
Vanni, F. Foglia, E. Pennestri, F. Ferrario, L. Banfi, G.	2020	Introducing enhanced recovery after surgery in a high-volume orthopedic hospital: a health technology assessment	Italy	Italy	single center, retrospective, mixed methods observational study	938 procedures	orthopedics, total knee arthroplasty, total hip arthroplasty	Surgical	Orthopedic, arthroplasty	full care path (full surgical episode)	Direct and indirect	provider	provider	ABC	Absorption costing - ABC	implemented		yes see second sheet
Click, B. Lopez, R. Arrigain, S. Schold, J. Regueiro, M. Rizk, M.	2020	Shifting Cost-drivers of Health Care Expenditures in Inflammatory Bowel Disease	US	US; various states		641 patients	IBS, bowel, crohn's, Inflamatory Bowel Disease, ulcerative colitis	Internal Medicine		full care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
Padilla, J. A. Gabor, J. A. Ryan, S. P. Long, W. J. Seyler, T. M. Schwarzkopf, R. M.	2020	Total Hip Arthroplasty for Femoral Neck Fracture: The Economic Implications of Orthopedic Subspecialty Training	US	US; various states		291 patients	orthopedics, total hip athroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursement as ratio of bundle price	no

Kaplan, A. L. Agarwal, N. Setlur, N. P. Tan, H. J. Niedzwiecki, D. McLaughlin, N. Burke, M. A.	2015	Measuring the cost of care in benign prostatic hyperplasia using time driven activity-based costing (TDABC)	US	US; California	single center, retrospective, direct observation	one care pathway, 5 surgical options	Urology, benign prostatic hyperplasia	Urology		partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		unspecified		yes see second sheet
Pang, J. Crawford, K. Faraji, F. Ramsey, C. Kemp, A. Califano, J. A.	2020	An Analysis of 1-Year Charges for Head and Neck Cancer: Targets for Value-Based Interventions	US	US; various states		196 consecutive patients	Oncology, head and neck cancer	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based		N/A	charges	no
Lobatto, D. J. Vlieland, Tpmv van den Hout, W. B. de Vries, F. de Vries, A. F. Schutte, P. J. Mantenaar, M. J. T.	2020	Feasibility, safety, and outcomes of a stratified fast-track care trajectory in pituitary surgery	The Netherlands	The Netherlands	prospective, observational study, process mapping	155 patients	Endocrinology, surgical, pituitary	endocrinology		partial care path (full surgical episode)	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic		Paper only		no
Patel, M. I. Ramirez, D. Agajanian, R. Agajanian, H. Coker, T.	2020	Association of a Lay Health Worker Intervention With Symptom Burden, Survival, Health Care Use, and Total Costs Among Medicare Enrollees With Cancer	US	US; various states		425 patients	Oncology	Oncology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based		N/A	charges	no
Jalilian, H. Doshmangir, L. Ajami, S. Mir, H. Siraneh, Y. Hasanpoor, E.	2019	Economic burden of gastric cancer in the first six months after diagnosis	Iran	Iran		118 patients	Oncology, bowel, gastric cancer	Oncology		unspecified	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic		Paper only		no
Lobatto, D. J. van den Hout, W. B. Najafabadi, A. H. Z. Steffens, A. N. V. Andela, C. D. Pereira, A. M. Peul, W. C.	2019	Healthcare utilization and costs among patients with non-functioning pituitary adenomas	The Netherlands	The Netherlands		167 patients	Endocrinology, Pituitary adenoma	endocrinology		partial care path	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic		N/A		no
Gray, C. F. Prieto, H. A. Deen, J. T. Parvataneni, H. K.	2019	Bundled Payment "Creep": Institutional Redesign for Primary Arthroplasty Positively Affects Revision Arthroplasty	US	US; Florida		168 patients	orthopedics, total joint arthroplasty	Surgical	Orthopedic, arthroplasty	full care path (surgical episode)	Direct and indirect	payer, provider	payer	provider	none; charges	Charges/Reimbursement-based	Direct costing	N/A		no
Kurt, P. Saban, M. Cankaya, F. Annac, M. C.	2019	Time-Driven Activity-Based Costing in the Ophthalmology Department of State Hospital: A Case Study	Turkey	Turkey	single center, retrospective, case study	case study; 5 surgical procedures in one department	Opthalmology	opthalmology		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
Thaci, B. McGirt, M. J. Ammerman, J. M. Thome, C. Kim, K. D. Ament, J. D.	2019	Reduction of direct costs in high-risk lumbar discectomy patients during the 90-day post-operative period through annular closure	US	US; California	randomized controlled trial,	272 patients	Surgical, high-risk lumbar discectomy	Surgical	Spine	partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based		N/A		no
Karns, M. R. Jones, D. L. Todd, D. C. Maak, T. G. Aoki, S. K. Burks, R. T. Yoo, M.	2018	Patient- and Procedure-Specific Variables Driving Total Direct Costs of Outpatient Anterior Cruciate Ligament Reconstruction	US	US; Utah	Retrospective cohort, single center, economic and decision analysis	434 patients	orthopedic, surgical, Anterior Cruciate Ligament Reconstruction, sports medicine	Surgical	Orthopedic	partial care path (full surgical episode)	Direct	provider	provider	VDO tool, total direct costs	Direct costing		implemented		yes see second sheet
Robinson, J. R. Carter, N. H. Gibson, C. Brinkman, A. S. Van Arendonk, K. Speck, K. E. Danko, M. E.	2018	Improving the value of care for appendectomy through an individual surgeon-specific approach	US	US; tennessee	prospective observational study	216 patients	Appendicitis, surgical	Surgical	Appendicitis	partial care path (full surgical episode)	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic		N/A		yes see second sheet
Gupta, P. Rettiganti, M.	2017	Relationship of Hospital Costs With Mortality in Pediatric Critical Care: A Multi-Institutional Analysis	US	US; various states	single center, pre and post intervention **(dashboard)**	917,663 patients, 47 hospitals	Acute care, pediatrics	pediatrics	Pediatric acute care	partial care path	unspecified	payer	payer	unspecified	Charges/Reimbursement-based		N/A	charges	no
Ilg, A. M. Laviana, A. A. Kamrava, M. Veruttipong, D. Steinberg, M. Park, S. J. Burke, M. A.	2016	Time-driven activity-based costing of low-dose-rate and high-dose-rate brachytherapy for low-risk prostate cancer	US	US; California	single center, retrospective, process mapping, direct observation	2 treatment options	Oncology, prostate cancer, brachytherapy	Oncology		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
McLaughlin, N. Burke, M. A. Setlur, N. P. Niedzwiecki, D. R. Kaplan, A. L. Saigal, C. Mahajan, A.	2014	Time-driven activity-based costing: a driver for provider engagement in costing activities and redesign initiatives	US	US; California	single center, process mapping	2 pilots	Urology, neurosurgery	Surgical	Neurosurgery	partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		implemented		no

Keating, C. L. Dixon, J. B. Moodie, M. L. Peeters, A. Playfair, J. O'Brien, P. E.	2009	Cost-Efficacy of Surgically Induced Weight Loss for the Management of Type 2 Diabetes A randomized controlled trial	Australia	Australia	randomized controlled trial,	40 patients, 23 surgical, 7 medical	Surgical, Diabetes	Internal Medicine		unspecified	Direct	provider	provider	direct costs	Direct costing	Paper only		no
Nelson, A. A. Pearce, D. J. Fleischer, A. B. Balkrishnan, R. Feldman, S. R.	2005	Infliximab for inpatient psoriasis management - is there a role?	US	US; Ohio		208 inpatient admissions	Psoriasis, Dermatology	Dermatology		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
Yanik, John M. Bedard, Nicholas A. Hanley, Jessica M. Otero, Jesse E. Callaghan, John J. Marsh, John L.	2018	Rapid Recovery Total Joint Arthroplasty is Safe, Efficient, and Cost-Effective in the Veterans Administration Setting	US	US; Iowa		78 patients	orthopedics, total hip athroplasty, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	unspecified		no
Zhang, Steven Vora, Molly Harris, Alex H. S. Baker, Laurence Curtin, Catherine Kamal, Robin N.	2016	Cost-Minimization Analysis of Open and Endoscopic Carpal Tunnel Release	US	US; California		16 million patient records	Carpal Tunnel Release	Surgical	Carpal Tunnel Release	full care path (surgical episode)	Direct and indirect	payer	payer	none, reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
A. Adenikinju, R. Ranson, S. A. Rettig, K. A. Egol and S. R. Konda	2021	Ability of a Risk Prediction Tool to Stratify Quality and Cost for Older Patients With Operative Distal Radius Fractures	US	US; New York			Orthorpedic, Geriatric, Operative Distal Radius Fractures	Surgical	Orthopedic fracture	unspecified	Direct and indirect	payer	payer	unspecified; Hospital accounting data not otherwise specified	Charges/Reimbursement-based	N/A	index admission cost, per category	no
A. Alibrahim, Y. Abdulsalam, S. Al Mutawa, H. Behbehani, D. Alhuwail and S. Al Jenaei	2021	Towards value-based healthcare: Establishing baseline pharmacy care costs for diabetes management	Kuwait	Kuwait	single center, observation, interviews	one pharmacy	Diabetes, pharmacy	Internal Medicine		partial care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		yes see second sheet
D. J. Baughman, A. Waheed, M. N. Khan and J. M. Nicholson	2021	Enhancing Value-Based Care With a Walk-in Clinic: A Primary Care Provider Intervention to Decrease Low Acuity Emergency Department Overutilization	US	US; Pennsylvania			Emergency care	emergency care & acute care		unspecified	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	average charges	no
J. A. Berinstein, S. A. Cohen-Mekelburg, G. M. Greenberg, D. Wray, S. K. Berry, S. D. Saini, A. M. Fendrick, M. A. Adams, A. K. Waljee and R. D. R. Higgins	2021	A Care Coordination Intervention Improves Symptoms But Not Charges in High-Risk Patients With Inflammatory Bowel Disease	US	US; Michigan			IBS/IBD inflammatory bowel disease	Internal Medicine		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
A. Beschloss, C. Dicindio, J. Lombardi, A. Varthi, A. Ozturk, R. Lehman, L. Lenke and C. Saifi	2021	Marked Increase in Spinal Deformity Surgery Throughout the United States	US	US; various states			Orthopedic, Spinal Deformity Surgery	Surgical	Spine	full care path	Direct and indirect	provider	provider	none; charges	Charges/Reimbursement-based	N/A	unspecified	no
H. Bueno, J. L. Bernal, V. Jimenez-Jimenez, F. J. Martin-Sanchez, X. Rossello, G. Moreno, C. Goni, V. Gil, P. Llorens, N. Naranjo, J. Jacob, R. Herrero	2021	The Clinical outcomes, healthcare resource utilization, and related costs (COHERENT) model. Application in heart failure patients	Spain	Spain	Retrospective, multi-center	30 day period of heart failure patients	heart failiure, cardiovascular	Cardiology		partial care path	Direct and indirect	provider	provider	DRG costs	Absorption costing - unspecified/generic	implemented		yes see second sheet
R. A. Burnett Iii, J. Yang, P. M. Courtney, E. B. Terhune, C. P. Hannon and C. J. Della Valle	2021	Costs of unicompartmental compared with total knee arthroplasty : a matched cohort study over ten years	US	US; various states			Total knee arthroplasty, orthopedic	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	provider	provider	none; reimbursements	Charges/Reimbursement-based	N/A	reimbursement	no
M. Casey, D. Perera, J. Enticott, H. Vo, S. Cubra, A. Gravell, M. Waerea and G. Habib	2021	High utilisers of emergency departments: the profile and journey of patients with mental health issues	Australia	Australia			Emergency care	emergency care & acute care		partial care path	Direct and indirect	provider	provider	unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic	N/A		yes see second sheet
K. A. Chovanec, C. Arsene, A. Beck and B. Liedel	2022	Why Not Home?: A Study of the Impact of an Effort to Reduce Postacute Expenditures	US	US; various states			Various, post-acute	emergency care & acute care		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
R. V. Cohen, A. M. Nishikawa, R. A. Ribeiro, F. M. Oliveira, P. C. Andrade, S. M. Junqueira and B. Toldo	2021	Surgical Management of Obesity in Brazil: Proposal for a Value-Based Healthcare Model and Preliminary Results	Brazil	Brazil			Obesity, surgical, bariatric surgery	Surgical	Bariatric	full care path	Direct and indirect	provider	provider	reference pricing	Absorption costing - unspecified/generic	N/A		yes see second sheet

A. P. B. da Silva Etges, L. N. Cruz, R. Schlatter, J. Neyeloff, R. B. Cardoso, L. Kopittke, A. A. Nunes, J. A. Neto, J. L. Nogueira, R. M. de Assis, L. S. P. Tobias, I.	2022	Time-driven activity-based costing as a strategy to increase efficiency: An analyses of interventional coronary procedures	Brazil	Brazil	multi center, retrospective, process mapping, 5 hospitals	5 hospitals, 90 patients	Interventional Coronary Procedures	Cardiology		full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		unspecified		yes see second sheet
M. Dziemianowicz, J. Burmeister and M. Dominello	2021	Examining the Financial Impact of Altered Fractionation in Breast Cancer: An Analysis Using Time-Driven Activity-Based Costing	US	US; Michigan	single center, retrospective, process mapping, direct observation, treatment comparison	2 treatment options, 50 patient visits total	Oncology, breast cancer, cancer, sentinel lymph node biobsy, Altered Fractionation in Breast Cancer	Oncology		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
C. Fang, A. Hagar, M. Gordon, C. T. Talmo, D. A. Mattingly and E. L. Smith	2021	Differences in Hospital Costs among Octogenarians and Nonagenarians Following Primary Total Joint Arthroplasty	US	US; Boston	single center, retrospective, patient comparison	889 surgeries	Geriatrics, Orthopedic, Primary Total Joint Arthroplasty	Surgical	Orthopedic fracture	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		unspecified		yes see second sheet
C. Fang, N. Pagani, M. Gordon, C. T. Talmo, D. A. Mattingly and E. L. Smith	2021	Episode-of-Care Costs for Revision Total Joint Arthroplasties by Decadal Age Groups	US	US; Boston	single center, retrospective, patient comparison	551 surgeries	Geriatrics, Orthopedic, Primary Total Joint Arthroplasty	Surgical	Orthopedic fracture	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		unspecified		yes see second sheet
C. J. Fang, J. M. Shaker, J. M. Drew, A. Jawa, D. A. Mattingly and E. L. Smith	2021	The Cost of Hip and Knee Revision Arthroplasty by Diagnosis-Related Groups: Comparing Time-Driven Activity-Based Costing and Traditional Accounting	US	US; Boston	single center, retrospective, process mapping	793 surgeries	Geriatrics, Orthopedic, Primary Total Joint Arthroplasty	Surgical	Orthopedic arthroplasty	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Absorption costing - unspecified/generic	Paper only		yes see second sheet
C. J. Fang, J. M. Shaker, P. A. Hart, C. Cassidy, D. A. Mattingly, A. Jawa and E. L. Smith	2021	Variation in the Profit Margin for Different Types of Total Joint Arthroplasty	US	US; Boston	single center, retrospective	13545 procedures	Geriatrics, Orthopedic, Primary Total Joint Arthroplasty	Surgical	Orthopedic arthroplasty	full care path (surgical episode)	Direct and indirect	provider, payer	provider	payer	TDABC	Absorption costing - TDABC	Charges/Reimbursement-based	unspecified		yes see second sheet
C. A. Feizpour, M. S. Patel, M. A. Syed, A. Carrasco, J. Shah, S. Hanish, L. Sosa, S. Fogus, S. Bennett, C. Shi, B. Hardman and P. A. Vasoß	2021	Enhanced recovery in liver transplantation: A value-based approach to complex surgical care	US	US; Texas	Retrospective, single center, pre and post intervention	379 liver transplant recipients	Surgical, enhanced recovery pathway, liver transplant	Surgical	Liver	full care path	Direct	provider	provider		direct costs	Direct costing		unspecified	unspecified	no
A. M. Fontebasso, S. Figueira, K. Thavorn, P. Glen, J. Lampron and M. Matar	2020	Financial implications of trauma patients at a Canadian level 1 trauma center: a retrospective cohort study	Canada	Canada			Surgical, Trauma surgery	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	provider	provider		unspecified; Hospital accounting data not otherwise specified	Absorption costing - unspecified/generic		N/A		no
M. Gandjian, C. Williamson, Y. Sanaiha, J. Hadaya, Z. Tran, S. T. Kim, S. Revels and P. Benharash	2021	Continued Relevance of Minimum Volume Standards for Elective Esophagectomy: A National Perspective	US	US; various			elective esophagectomy, cardiovascular	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	provider (proxy)	payer		none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy		N/A	charges, transformed with cost-to-charge ratio	no
I. M. Ganske, K. Sanchez, E. Le, O. C. Langa, B. Sharif-Askary, E. Ross, P. Santiago, J. G. Meara, B. L. Padwa and A. C. Alloi	2021	Time-Driven, Activity-Based Costing of Presurgical Infant Orthopedics: A Critical Component of Establishing Value of Latham Appliance and Nasoalveolar Molding	US	US; Boston	multi center, prospective, process mapping, direct observation	37 patients, two hospitals	pediatric, crainiofacial, presurgical infant orthopedics, plastic surgery, reconstructive surgery, Latham device	Pediatrics	Pediatric Plastic surgery	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC		Paper only		yes see second sheet
H. C. Gillis, K. Dolan, C. L. Sargel, R. Z. Thompson and J. E. Lutmer	2021	A Quality Improvement Approach to Influence Value-based Mucolytic Use in the PICU	US	US; Ohio			pediatric, pediatric intensive care, PICU, Mucolutic aerosols	Pediatrics	Pediatric acute care	partial care path	Direct	provider	provider		direct costs (medicine costs)	Direct costing		N/A		no
J. Hadaya, Y. Sanaiha, R. Hernandez, Z. Tran, R. J. Shemin and P. Benharash	2021	Impact of hospital volume on resource use after elective cardiac surgery: A contemporary analysis	US	US; various			elective cardiac surgery	Surgical	Cardiac/Thoracic	unspecified	Direct and indirect	provider (proxy)	payer		none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy		N/A	charges, transformed with cost-to-charge ratio	no
M. K. Islam, S. Ruths, K. Jansen, R. Falck, M. R. Molken and J. E. Askildsen	2021	Evaluating an integrated care pathway for frail elderly patients in Norway using multi-criteria decision analysis	Norway	Norway			geriatrics, frail elderly, multi-morbidity	Geriatrics		unspecified	Direct and indirect	provider, patient	provider	patient	reference pricing	Absorption costing - unspecified/generic	Charges/Reimbursement-based patient OoO	N/A		no
D. W. Jang, H. J. Lee, P. G. Chen, S. M. Cohen and C. D. Scales	2021	Geographic Variations in Healthcare Utilization and Expenditure for Chronic Rhinosinusitis: A Population-Based Approach	US	US; various			surgical, head and neck, Chronic rhinosinusitis	Surgical	ENT	full care path	Direct and indirect	payer	payer		none; charges	Charges/Reimbursement-based		N/A	charges	no

H. Ko, D. S. Brodke, M. E. Vanneman, A. J. Schoenfeld and B. I. Martin	2021	Is Discretionary Care Associated with Safety Among Medicare Beneficiaries Undergoing Spine Surgery?	US	US; various			spine surgery, surgical	Surgical	Spine	partial care path	Direct and indirect	payer	payer	none; reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
S. R. Konda, J. R. Johnson, N. Dedhia, E. A. Kelly and K. A. Egol	2021	Can We Stratify Quality and Cost for Older Patients With Proximal and Midshaft Humerus Fractures?	US	US; various			Humerus Fractures, geriatrics, orthopedic	Surgical	Orthopedic fracture	unspecified	Direct	provider	provider	direct variable costs as an estimation of total costs	Direct costing	N/A		no
A. T. Malik, S. N. Khan, R. T. Voskuil, J. H. Alexander, J. P. Drain and T. J. Scharschmidt	2021	What Is the Value of Undergoing Surgery for Spinal Metastases at Dedicated Cancer Centers?	US	US; various			Orthopedic, Surgical, spine surgery	Oncology		partial care path	Direct and indirect	payer	payer	none; reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
T. R. McClintock, D. F. Friedlander, A. Y. Feng, M. A. Shah, D. J. Pallin, S. L. Chang, A. M. Bader, T. W. Feeley, R. S. Kaplan and G. E. Hutchins	2021	Determining Variable Costs in the Acute Urolithiasis Cycle of Care Through Time-Driven Activity-Based Costing	US	US; Boston	multi center, retrospective, process mapping, journey mapping	unspecified number of patients, acute stone episodes	Acute Urolithiasis	emergency care & acute care		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		yes see second sheet
R. Negrini, R. D. da Silva Ferreira and D. Z. Guimaraes	2021	Value-based care in obstetrics: comparison between vaginal birth and caesarean section	Brazil	Brazil	single center, retrospective, process mapping	9345 deliveries	Obstetrics, birth, vaginal birth, caesarean birth	gynecology & obstetrics		full care path	Direct and indirect	provider	provider	direct and indirect costs	Absorption costing - unspecified/generic	Paper only		yes see second sheet
T. V. Newman, K. D. Munshi, L. M. Neilson, C. B. Good, E. C. S. Swart, Y. Huang, R. Henderson and N. Parekh	2021	Health care utilization and costs associated with switching from DPP-4i to GLP-1RA or SGLT2i: an observational cohort study	US	US; various			Diabetes	Internal Medicine		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
N. Panda, L. Shagabayeva, C. E. Comrie, N. Phan, P. Moonsamy, C. F. Jeffrey Yang, F. G. Fernandez and C. R. Mayo	2022	Drivers of Cost Associated With Minimally Invasive Esophagectomy	US	US; Boston			esophagectomy, surgical, thoracic surgery	Surgical	Cardiac/Thoracic	full care path	Direct	provider	provider	direct costs	Direct costing	N/A		no
S. K. Pasquali, D. Thibault, M. Hall, K. Chiswell, J. C. Romano, J. W. Gaynor, D. M. Shahian, M. L. Jacobs, M. G. Gaies, S. M. O'Brien, E. C. Norton	2021	Evolving Cost-Quality Relationship in Pediatric Heart Surgery	US	US; Boston	Retrospective, multi-center	45315 patients, 32 hospitals	pediatrics, surgical, pediatric heart surgery	Pediatrics	Pediatric surgical	full care path	direct and indirect	provider	provider	CHD-method standardized costs	Absorption costing - unspecified/generic	Paper only		no
R. K. Sethi, R. P. Pumpian, C. E. Drolet and P. K. Louie	2021	Utilizing Lean Methodology and Time-Driven Activity-Based Costing Together: An Observational Pilot Study of Hip Replacement Surgery Utilizing a New Method to Study Value-Based Health Care	US	US; Washington	single center, retrospective, surgeon comparison	346 patients	surgical, orthopedic, hip replacement surgery, anterior hip arthroplasty	Surgical	Orthopedic, arthroplasty	full care path (surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
N. G. Thaker, D. Boyce-Fappiano, M. S. Ning, D. Pasalic, A. Guzman, G. Smith, E. B. Holliday, J. Incalcaterra, A. S. Garden, S. E.	2021	Activity-Based Costing of Intensity-Modulated Proton versus Photon Therapy for Oropharyngeal Cancer	US	US; Texas	single center, process mapping, matched sample	50 patients (matched pairs)	oncology, radiation oncology	Oncology		partial care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	implemented		yes see second sheet
S. Tomicki, G. Dieguez, H. Latimer, P. Cockrum and G. Kim	2021	Real-World Cost of Care for Commercially Insured versus Medicare Patients with Metastatic Pancreatic Cancer Who Received Guideline-Recommended Therapies	US	US; various			oncology, metastatic pancreatic cancer	Oncology		full care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
W. Wang, E. Li, K. Campbell, A. McBride and S. D'Amato	2021	Economic Analysis on Adoption of Biosimilar Granulocyte Colony-Stimulating Factors in Patients With Nonmyeloid Cancer at Risk of Febrile Neutropenia Within the Oncology Care Model Framework	US	US; New Jersey			oncology, Nonmyeloid Cancer	Oncology		partial care path	Direct	provider	provider	direct costs	Direct costing	N/A		no
K. L. Wise, H. R. Parikh, B. Okelana, A. J. Only, M. Reams, A. Harrison, J. Braman, E. Craig and B. P. Cunningham	2022	Measurement of value in rotator cuff repair: patient-level value analysis for the 1-year episode of care	US	US; Minnesota	single center, retrospective, process mapping	396 patients	orthopedic, surgical, rotator cuff repair	Surgical	Orthopedic rotator cuff repair	full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		yes see second sheet
C. Iloabuchi, N. Dwibedi, T. LeMasters, C. Shen, A. Ladani and U. Sambamoorthi	2021	Low-value care and excess out-of-pocket expenditure among older adults with incident cancer – A machine learning approach	US	US; various			oncology, incident cancer	Oncology		full care path	Direct	patient	patient	total out of pocket expenditures (SEER data)	Charges/Reimbursement-based patient OoO	N/A		no

N. Seyidova, A. D. Chen, D. del Valle, D. Chi, R. P. Cauley, B. T. Lee and S. J. Lin	2021	Nationwide cost variation for lower extremity flap reconstruction	US	US; various			lower extremity flap reconstruction, surgical, plastic surgery	Surgical	Plastic surgery	full care path	Direct and indirect	provider (proxy)	payer	none; charges, transformed with cost-to-charge ratio	Charges/Reimbursement-based proxy	N/A	charges, transformed with cost-to-charge ratio	no
A. Jacir, D. Mendoza, E. Dean and H. Gitlow	2021	The cost of care during times of COVID: Case study of TDABC and minimum utilization cost analysis in a medicare advantage population	US	US; Florida	single center, process mapping, case study	case study, telehealth visits	Covid	Infectious disease		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	unspecified		no
D. Fürstenau, H. Haneke, C. Spies, T. Walz, K. Schewina, M. Höft, R. Mörgeli and F. Balzer	2021	Tackling the frailty burden with an integrative value-based approach: results from a mixed-methods study	Germany	Germany			surgical, perioperative process	Surgical	other	partial care path	unspecified	provider	provider	bottom-up clinical costing approach	Unspecified	N/A		no
J. F. Buell, A. N. Flaris, S. Raju, A. Hauch, M. Darden and G. G. Parker	2021	Long-Term Outcomes in Complex Abdominal Wall Reconstruction Repaired with Absorbable Biologic Polymer Scaffold (Poly-4-Hydroxybutyrate)	US	US; North Carolina			Surgical, abdominal wall reconstruction, rehernia tion, complex abdominal wall hernia	Surgical	Abdominal	partial care path	Direct	payer	payer	none; charges	Charges/Reimbursement-based	N/A		no
V. J. Siu, T. Varkey, U. N. Khan, J. B. Ding and S. Gandhi	2021	Lend Me a Hand: A Value-Based Care Case Study on Pan Plexopathy of Unknown Origin	US	US; Texas			pan plexopathy, neurology, brachial plexus injury	Neurology		unspecified	Direct	patient	patient	out of pocket costs to patient	Charges/Reimbursement-based patient OoO	N/A		no
J. B. Kukreja, M. A. Seif, M. W. Mery, J. R. Incalcaterra, A. M. Kamat, C. P. Dinney, J. B. Shah, T. W. Feeley and N. Navai	2021	Utilizing time-driven activity-based costing to determine open radical cystectomy and ileal conduit surgical episode cost drivers	US	US; Texas	single center, retrospective, process mapping	100 patients	open radical cystectomy, urology, oncology, bladder cancer	Oncology		full care path	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	Paper only		yes see second sheet
King, B. C. Richardson, T. Patel, R. M. Lee, H. C. Bamat, N. A. Hall, M. Slaughter, J. L.	2021	Prioritization framework for improving the value of care for very low birth weight and very preterm infants	US	US; Texas	Retrospective cohort, multi center	26098 preterm or low birth weight infants	Preterm infants, neonatal, perinatology, pediatrics	Pediatrics	Pediatric Neonatal	partial care path	Direct and indirect	payer	payer	charges standardized across hospitals	Charges/Reimbursement-based	N/A	charges	no
L. Fernando-Canavan, A. Gust, A. Hsueh, A. Tran-Duy, M. Kirk, P. Brooks and J. Knight	2021	Measuring the economic impact of hospital-acquired complications on an acute health service	Australia	Australia	single center, retrospective, mixed methods observational study	93 056 cases	emergency care, hospital acquired complications	emergency care & acute care		partial care path	Direct and indirect	provider	provider	bottom-up clinical costing approach	Absorption costing - unspecified/generic	unspecified		yes see second sheet
H. Skibicki, M. Yayac, C. A. Krueger and P. M. Courtney	2021	Target Price Adjustment for Hip Fractures Is Not Sufficient in the Bundled Payments for Care Improvement Initiative	US	US; Pennsylvania			arthroplasty, hip fractures, orthopedics	Surgical	Orthopedic, arthroplasty	full care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges (EOC costs)	no
D. Clewley, Y. Iftikhar, M. E. Horn and D. I. Rhon	2020	Do the Number of Visits and the Cost of Musculoskeletal Care Improve Outcomes? More May Not Be Better	US	US; Texas	Retrospective, clinical trial	98 patients	Subacromial pain syndrome	Pain medicine		partial care path	Direct and indirect	payer	payer	none; reimbursements	Charges/Reimbursement-based	N/A	reimbursements	no
B. Walker, L. Wilfong, J. Frytak and N. Robert	2021	Practice patterns among oncologists participating in the oncology care model after three years	US	US; Louisiana			oncology, cancer	Oncology		full care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
C. A. Krueger, M. Yayac, C. Vannello, J. Wilsman, M. S. Austin and P. M. Courtney	2021	Are We at the Bottom? BPCI Programs Now Disincentivize Providers Who Maintain Quality Despite Caring for Increasingly Complex Patients	US	US; Pennsylvania			orthopedic, total hip arthroplasty, total knee arthroplasty	Surgical	Orthopedic, arthroplasty	partial care path	Direct and indirect	payer	payer	none; reimbursement	Charges/Reimbursement-based	N/A	reimbursement	no
B. S. Horton, J. D. Marland, H. S. West and J. D. Wylie	2021	Transition to Telehealth Physical Therapy After Hip Arthroscopy for Femoroacetabular Impingement: A Pilot Study With Retrospective Matched-Cohort Analysis	US	US; Utah	Pilot		orthopedics, hip athroscopy, physical therapy	Orthopedic		partial care path	Direct and indirect	payer	payer	none; charges	Charges/Reimbursement-based	N/A	charges	no
N. H. Nguyen, J. Luo, L. Ohno-Machado, W. J. Sandborn and S. Singh	2021	Burden and Outcomes of Fragmentation of Care in Hospitalized Patients With Inflammatory Bowel Diseases: A Nationally Representative Cohort	US	US; California			Gastroenterology, Inflammatory Bowel Diseases	Internal Medicine		full care path	Direct and indirect	provider (proxy)	payer	none; charges HCUP data	Charges/Reimbursement-based	N/A	charges	no

Y. Sanaiha, P. Downey, R. Lyons, A. Nsair, R. J. Shemin and P. Benharash	2021	Trends in utilization, mortality, and resource use after implantation of left ventricular assist devices in the United States	US	US; various			cardiovascular, left ventricular assist devices	Surgical	Cardiac/Thoracic	full care path	Direct and indirect	provider (proxy)	payer	none; reimbursements, cost-charge-ratio, NIS data	Charges/Reimbursement-based proxy	N/A	charges transformed with cost-to-charge ratio	no
Khanijow, A. N. Wood, L. N. Xie, R. Theiss, L. M. Hollis, R. H. Hardiman, K. M. Connolly, D. J.	2021	The impact of an enhanced recovery program (ERP) on the costs of colorectal surgery	US	US; Alabama	single center, retrospective	616 surgical cases	surgical, colorectal surgery	Surgical	Colon/Rectal	partial care path (full surgical episode)	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	Paper only		yes see second sheet
Jacobs, K. Dewilde, T. Vandoren, C. Cardoen, B. Vansteenkiste, N. Scheys, L. Roodhooft, F.	2020	Variability in Hospital Costs of Adult Spinal Deformity Care	The Netherlands	The Netherlands	single center, retrospective	139 patients	Surgical, spine, Adult Spinal Deformity	Surgical	Spine	full care path	Direct	provider	provider	ABC (excluding overheads)	Absorption costing - ABC	Paper only		yes see second sheet
Mattar, D. Di Filippo, A. Invento, A. Radice, D. Burcuta, M. Bagnardi, V. Maggioni, E.	2021	Economic implications of ACOSOG Z0011 trial application into clinical practice at the European Institute of Oncology	Italy	Italy	single center, retrospective, clinical trial, compare pre and post	3912 patients	oncology, breast cancer, cancer, sentinel lymph node biobsy	Oncology		partial care path (full surgical episode)	Direct and indirect	provider	provider	TDABC	Absorption costing - TDABC	implemented		yes see second sheet
Weir, T. B. Usmani, M. F. Camacho, J. Sokolow, M. Bruckner, J. Jazini, E. Iavagnoli, L. I.	2021	Effect of Surgical Setting on Cost and Hospital Reported Outcomes for Single-Level Anterior Cervical Discectomy and Fusion	US	US; Maryland	multi center, retrospective	301 patients	Spine, surgical, Anterior Cervical Discectomy and Fusion	Surgical	Spine	full care path	Direct and indirect	provider	provider	unspecified	Absorption costing - unspecified/generic	Paper only		no

Inclusions RQ2 (49) extracted data to be shared with Erasmus Data Repository (FigShare)

	Study characteristics						Costing method characteristics					Value-Based consequences of costing information (facilitators)			
year	Reference	Medical Specialty	Costing method	Costing period	Centre	Study type	PM: Process Mapping	EI: Expert Input	DO: Direct Observation	CG: Cost grouping, either per item or per activity, or both	Benchmarking across/Compare costs across	Identification of Cost Drivers	Measured cost difference	Care path adjustment(s)
2022	(Alibrahim et al., 2022)	Internal medicine	TDABC	partial	single	retro	yes	yes		items, activities		yes		suggested
2022	(Wise et al., 2022)	Surgical, orthopaedic, rotator cuff re	TDABC	full (FSE)	single	retro	yes		yes	items, activities	surgeons, two alternative treatments within one care path	yes	yes, ± $727 about the mean per patient	suggested
2021	(Etges et al., 2021)	Cardiology (incl. several surgeries)	TDABC	full (FSE)	multi	retro	yes	yes	yes	items, activities	hospitals, interventional coronary procedures	yes	yes, estimate 51.0% of procedure cost	yes
2021	(Dziemianowicz et al., 2021)	Oncology	TDABC	full	single	retro	yes	yes	yes	items, activities	treatment care paths (accelerated whole breast irradiation vs. usual care)	yes	$2,302 (25.0%) difference across treatments	suggested
2021	(Fang, Hagar, Gordon, et al., 2021)	Surgical, orthopaedic fracture	TDABC	full (FSE)	single	retro	yes			items, activities	patients	yes		suggested
2021	(Fang, Shaker, Drew, et al., 2021)	Surgical, orthopaedic, arthroplasty	TDABC	full (FSE)	single	retro	yes		yes	items, activities	costing methods (TA and TDABC)	yes		suggested
2021	(Fang, Shaker, Hart, et al., 2021)	Surgical, orthopaedic, arthroplasty	TDABC	full (FSE)	single	retro	yes		yes	items, activities	five treatments (total joint arthroplasties), cost vs. reimbursement	yes		
2021	(Ganske et al., 2021)	Paediatric, surgical, plastic surgery	TDABC	full (FSE)	multi	Pro	yes		yes	items, activities	treatment care paths	yes	up to $8900 if surgery was required, but long-term outcomes yet	suggested
2021	(McClintock et al., 2021)	Emergency & acute care	TDABC	full (multiple)	multi	retro	yes	yes	yes	items, activities	eight care paths for acute ureteral stones (patient journeys)	yes	yes, $6614 difference across care paths	suggested
2021	(Sethi, Pumpian, Drolet, & Louie, 2021)	Surgical, orthopaedic arthroplasty	TDABC	full (FSE)	single	retro	yes		yes	items, activities	surgeons	yes		suggested
2021	(Thaker et al., 2021)	Oncology	TDABC	partial	single	pro	yes	yes	yes	items, activities	treatments (matched sample, intensity-modulated proton vs. photon therapy) and individual care paths	yes	yes, cost difference of up to 3.33 times, depending on patient	suggested
2021	(Kukreja et al., 2021)	Oncology (incl. surgery)	TDABC	full	single	retro	yes		yes	items, activities		yes		suggested
2021	(Mattar et al., 2021)	Oncology	TDABC	partial (FSE)	single	retro	yes			items	pre and post implementation of Z0011 guidelines in oncology	yes	yes, mean cost savings of €309 per patient	yes
2021	(Bueno et al., 2021)	Cardiology	AC (other)	partial	multi	retro				items	patient journeys	yes		suggested
2021	(Casey et al., 2021)	Emergency & acute care	AC (other)	partial	single	retro	yes			items	surgeons	yes		
2021	(Cohen et al., 2021)	Surgical, bariatric	AC (other)	full (FSE)	single	retro				items	treatment	yes		
2021	(Negrini, da Silva Ferreira, & Guimaraes	Gynaecology & obstetrics	AC (other)	full	single	retro	yes			items, activities	procedures	yes	yes, $967 per patient	suggested
2021	(Fernando-Canavan et al., 2021)	Emergency & acute care	AC (other)	partial	single	retro				items, activities		yes		
2021	(Khanijow et al., 2021)	Surgical, colorectal	AC (other)	partial (FSE)	single	retro				items	intervention	yes	yes, reduced variable cost, similar total cost	yes
2020	(Wise et al., 2020)	Surgical, orthopaedics, fracture	ABC	partial (FSE)	single	retro				items	patients, patient groups, demographics	yes		
2020	(Vanni, Foglia, Pennestri, Ferrario, & Ba	Surgical, orthopaedic, arthroplasty	ABC	full (FSE)	single	both		yes	yes	items, activities	treatment care paths (enhanced recovery after surgery)	yes	estimate €2,054,000 annually	yes
2020	(Jacobs et al., 2020)	Surgical, spine	ABC	l, 1 year (incl. surgeri	single	retro	yes			items, activities	patients, patient groups	yes		suggested
2020	(Bodar et al., 2020)	Paediatric, surgical	TDABC	full (FSE)	single	both	yes		yes	items, activities	costing methods (TA and TDABC)	yes	20.0% and without care path alteration	suggested
2020	(Ning et al., 2020)	Oncology	TDABC	full (FSE)	single	retro	yes	yes	yes	items, activities	treatment care paths (MRI-guided vs. usual care)	yes	yes, estimate for each 10.0% decrease in case duration from baseline	suggested
2020	(Ahluwalia et al., 2020)	Surgical, orthopaedics fracture	TDABC	full (FSE)	single	pro	yes	yes	yes	items, activities	treatment care paths (home care vs. usual care), costs vs. reimbursements	yes	£2,018 per patient	suggested
2020	(Caloway et al., 2020)	Paediatric, neonatal	TDABC	partial	single	retro	yes	yes	yes	items, activities	before and after intervention (family-centred care coordination program)	yes	yes, 36.0% or $92,000 per tracheostomy care cycle	yes
2020	(Burnhope et al., 2020)	Surgical, cardiac/thoracic	AC (other)	partial	multi	retro	yes			items	patients, implant devices	yes		suggested
2020	(Lenfant, Sawczyn, Kim, Aminsharifi, &	Oncology, surgical	AC (other)	partial	single	retro				items		yes	yes, multiple	
2019	(Hernandez, Kaplan, Witkowski, Faison,	Multiple	TDABC	full	multi, pilot	retro	yes	yes	yes	items, activities	before and after intervention (IPUs)	yes	yes, quarterly costs declined	suggested
2019	(Basto, Chahal, & Riedel, 2019)	Oncology	TDABC	partial (PSE)	single	pro	yes		yes	items, activities	treatment care paths (parallel vs. induction design in OR)	yes	yes, estimate OR time reduction of 55 min, or $,2818 missed revenue	suggested
2019	(McCreary et al., 2019)	Surgical, orthopaedics fracture	TDABC	partial (FSE)	single	both	yes			items		yes		suggested
2019	(Ahluwalia et al., 2019)	Surgical, foot debridement	TDABC	partial (FSE)	single	retro			yes	items	before and after intervention (traffic-light principle)	yes		yes
2019	(Kurt, Saban, Cankaya, & Annac, 2019)	Ophthalmology	TDABC	ull (entire department	single	retro	yes	yes	yes	items, activities		yes		suggested
2019	(Danilyants, MacKoul, van der Does, Hav	Gynaecology & obstetrics (incl. surgery)	AC (other)	partial (FSE)	single	retro				items		yes		suggested
2019	(Danilyants, MacKoul, Baxi, van der Doe	Gynaecology & obstetrics (incl. surg	AC (other)	partial (FSE)	single	retro				items		yes		
2019	(Chatfield et al., 2019)	Multiple	Direct costing	partial	single	retro				items		yes		
2019	(Featherall et al., 2019)	Surgical, orthopaedic arthroplasty	Direct costing	full (FSE)	multi	retro				items	intervention		yes, £255 per patient	yes
2018	(Martin et al., 2018)	Surgical, carpal tunnel release	TDABC	partial (FSE)	multi	retro	yes		yes	items, activities	multiple treatment care paths (colonoscopy, aortic valve replacement, Carpal Tunnel Release)	yes	yes, 70.9% ($27,103) and 31.6% ($178)	yes
2018	(Robinson et al., 2018)	Surgical, appendicitis	AC (other)	partial (FSE)	single	pro		yes	yes	items	pre and post intervention (dashboard)	yes	yes, decreased by $496 per operation	yes
2018	(Karns et al., 2018)	Surgical, orthopaedic	Direct costing	partial (FSE)	single	retro		yes		items	intervention	yes		
2017	(Isaacson et al., 2017)	Urology	TDABC	partial	single	Pro	yes		yes	items, activities		yes	yes, estimate two hours per cycle	suggested
2017	(Yu et al., 2017)	Paediatrics, appendicitis	TDABC	full (FSE)	single	pro	yes	yes	yes	items, activities	treatment care paths (pre and post intervention)	yes	11.0% cost reduction, and 51.0% hospitalization time	yes, several
2017	(Parra et al., 2017)	Urology	AC (other)	partial	multi	retro		yes		items				
2016	(French et al., 2016)	Oncology, surgical	TDABC	tial (FSEs, 11 surgeri	single	retro	yes			items, activities	potential staffing ratios	yes	estimate 13.0-28.0% per surgery type	odelled and suggested
2016	(Ilg et al., 2016)	Oncology	TDABC	full	single	retro	yes	yes	yes	items, activities	treatments (high-dose vs. low-dose brachytherapy)	yes	$2,668 difference across treatments	yes
2015	(Kaplan et al., 2015)	Urology	TDABC	partial (FSE)	single	retro	yes	yes		items, activities	five treatment care paths	yes	yes, 400.0% increase from least to most exensive nathwavs	suggested
2014	(McLaughlin, Upadhyaya, et al., 2014)	Surgical, neurosurgery	ABC	partial (FSE)	single	retro	yes			items, activities	patients	yes	yes, 25.0%	yes, several
2014	(McLaughlin, Martin, et al., 2014)	Surgical, neurosurgery	ABC	partial (FSE)	single	retro	yes			items, activities	patients	yes		suggested
2011	(Abbott & Meara, 2011)	Paediatric plastic surgery	ABC	al, 1 year (incl. surge	single	retro				items	patients	yes		suggested
						Count	*34*	*16*	*24*		*39*	*47*	*26*	*40*

PRISMA 2020 for Abstracts Checklist

Section and Topic	Item #	Checklist item	Reported (Yes/No)
TITLE			
Title	1	Identify the report as a systematic review.	yes
BACKGROUND			
Objectives	2	Provide an explicit statement of the main objective(s) or question(s) the review addresses.	yes
METHODS			
Eligibility criteria	3	Specify the inclusion and exclusion criteria for the review.	yes
Information sources	4	Specify the information sources (e.g. databases, registers) used to identify studies and the date when each was last searched.	yes
Risk of bias	5	Specify the methods used to assess risk of bias in the included studies.	no
Synthesis of results	6	Specify the methods used to present and synthesise results.	yes
RESULTS			
Included studies	7	Give the total number of included studies and participants and summarise relevant characteristics of studies.	yes
Synthesis of results	8	Present results for main outcomes, preferably indicating the number of included studies and participants for each. If meta-analysis was done, report the summary estimate and confidence/credible interval. If comparing groups, indicate the direction of the effect (i.e. which group is favoured).	yes
DISCUSSION			
Limitations of evidence	9	Provide a brief summary of the limitations of the evidence included in the review (e.g. study risk of bias, inconsistency and imprecision).	yes
Interpretation	10	Provide a general interpretation of the results and important implications.	yes
OTHER			
Funding	11	Specify the primary source of funding for the review.	yes
Registration	12	Provide the register name and registration number.	N/A

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: http://www.prisma-statement.org/

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	pg 0
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	pg1-3
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	pg 3
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	pg 4 and supplement
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Pg 4 and supplement
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Supplement
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	pg 6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	pg 6
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	pg 4, supplement
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	pg 4, supplement
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	pg 4, supplement
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	pg 4
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	pg 8
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	N/A
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	pg 8
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	pg 4
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A, discussed pg 23
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A

PRISMA 2020 Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	pg 5,6, 7
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	pg 5 (flowchart)
Study characteristics	17	Cite each included study and present its characteristics.	pg 7-14, and supplement
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	N/A
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	N/A
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	N/A
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	pg 7-9
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	pg 18-21
	23b	Discuss any limitations of the evidence included in the review.	pg 21
	23c	Discuss any limitations of the review processes used.	pg 21, 4
	23d	Discuss implications of the results for practice, policy, and future research.	pg 18-21
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	pg 4
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	supplement
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	Funding statement
Competing interests	26	Declare any competing interests of review authors.	Author statement
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Data availability statement

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