

## PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (<http://bmjopen.bmj.com/site/about/resources/checklist.pdf>) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

### ARTICLE DETAILS

<b>TITLE (PROVISIONAL)</b>	Cost measurement in value-based health care: a systematic review
<b>AUTHORS</b>	Leusder, Maura; Porte, Petra; Ahaus, Kees; van Elten, Hilco

### VERSION 1 – REVIEW

<b>REVIEWER</b>	St John, Andrew Drajon Health
<b>REVIEW RETURNED</b>	03-Sep-2022

<b>GENERAL COMMENTS</b>	<p>I am a clinical scientist with an interest in value as it applies to my own area so I have little detailed understanding of health finance and issues such as cost accounting. So I am not sure I am the best person to review what is a complex and difficult area. This review highlights principally that there is immense variability in the approaches being taken to identify value based healthcare. But the review is useful in highlighting what are likely to be the best approaches including TDABC.</p> <p>Some comments which are relatively minor and are about bringing greater clarity are: I am not sure the title needs the phrase "fact or fiction" at the end? Better left out perhaps. Page 3 Under Design Line 4, the word screen should be replaced with searched Page 3 Under Conclusions, line 0 the word prized should be replaced with viewed or seen Page 4 Under First bullet point, first line should read "this systematic review analyses all value based ..." Page 4 Under second bullet point, as currently written this is not clear and perhaps better stated as " We have identified four types of cost measurement which facilitate value-based healthcare" Page 6, para 2 ,line 8, golden should be gold Page 7 Last para of Introduction, mention is made of the review drawing on accounting literature - it might be useful to say what that literature provides in terms of the key categories to classify methods? Page 8 Two bullet points under Study Eligibility state Cost Measurement method used and the same applied - I am not clear what is the difference here?? Page 14 The text talks about a first method being direct costing and then in the next paragraph talks about absorption costing which I assume this is the second method and perhaps that should be stated clearly at the beginning of the second para? Page 20 Line 1 says several studies compared costs calculated with traditional accounting costs or reimbursemernt - I am not clear what is being said here?</p>
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	Page 20 second para - last line says "Both studies found costs to be unrelated to patient-reported outcome measures" This seems to be an important statement which could do with more explanation?
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<b>REVIEWER</b>	Olthof, Marijke University of Groningen
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<b>REVIEW RETURNED</b>	21-Sep-2022
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<b>GENERAL COMMENTS</b>	<p>Thank you for submitting this comprehensive and extensive manuscript.</p> <p>I think you addressed the research questions very thoroughly. I only have some minor comments:</p> <ul style="list-style-type: none"> <li>- Please pay attention to the English used: there are quite some grammatical issues and typo's</li> <li>- Introduction: Porter's value equation and the triple aim require more explanation</li> <li>- Quite long introduction: appears to be addressing too many subjects. The alinea "considerable ... costs" could be left out. The alinea "Though ... delivered" could also be shortened.</li> </ul> <p>I'm pleased with the explanation and analysis of the difference between actual hospital costs and reimbursements.</p>
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### VERSION 1 – AUTHOR RESPONSE

Reviewer's comments

Reviewer 1 - Dr. Andrew St John, Drajon Health, ARC Consulting

Dear Dr. St John,

Thank you for taking the time to review our manuscript carefully and for clearly formulating several points of improvement. We understand that, overall, your comments address the clarity of the text. To improve the clarity and readability we have enlisted a professional copyeditor, so you will notice many small adjustments throughout the entire manuscript. We instructed the copyeditor to clarify where possible without changing the argumentation or overall order of paragraphs. We have discussed each point of feedback within the author team – please find our responses to your comments below. Again, thank you for taking the time – where possible we have adopted your suggested phrasing. In some cases, the copyeditor suggested phrasing that was slightly different to yours – in those cases we explain the rationale behind the phrasing below.

Comment 1: I am not sure the title needs the phrase "fact or fiction" at the end? Better left out perhaps.

We understand that this is a provocative title. We have become quite attached to this title because we want to highlight the policy buzz surrounding VBHC on one hand, and on the other hand the high degree of variability in how value-based healthcare studies measure costs (or: the fact that many do not measure costs at all and rely on prices instead). This contradicts the concept of 'value-based' healthcare, which is why we view this critically. It seems that, to us, many studies use the term 'value-based' but do not adhere to the theoretical underpinnings of this concept. This is problematic because costs and prices are unrelated and measuring the value of care accurately requires using organizational costs from the provider/hospital perspective. We hope that this review encourages scholars and practitioners to measure costs. Our preference is to keep the title as it is, but if you or the editor still would prefer to remove "science or fiction?" from the title, we will obviously do so accordingly.

Comment 2: Page 3 Under Design Line 4, the word screen should be replaced with searched  
Thank you for reading the text so attentively. We have replaced the term 'screen' with 'search'.

Comment 3: Page 3 Under Conclusions, line 0 the word prized should be replaced with viewed or seen

We agree with your comment because we think that 'viewed' is more easily understood. We have replaced 'prized' with 'viewed'.

Comment 4: Page 4 Under First bullet point, first line should read "this systematic review analyses all value based ..."

We agree with this comment and have removed 'all' from the sentence.

Comment 5: Page 4 Under second bullet point, as currently written this is not clear and perhaps better stated as " We have identified four types of cost measurement which facilitate value-based healthcare"

We have rephrased this bullet point and removed the typo. It now reads as follows:

- This research operationalizes the benefits of cost measurement to practitioners by identifying four mechanisms through which cost information facilitates value-based healthcare.

We did not fully adopt your phrasing suggestion here because we identify four mechanisms through which cost information facilitates decision-making, not necessarily four types of cost measurement. We fear that using a different term other than 'mechanism' would be confusing to readers who read the entire manuscript and then come back to the strengths and limitations. To improve clarity, we have reordered the sentence of this second bullet point based on advice we received from the professional copyeditor.

Comment 6: Page 6, para 2, line 8, golden should be gold

You are correct – we have adjusted 'golden' to 'gold'. Some of the literature we cite refers to it as 'golden', but we agree with you that 'gold' is correct.

Comment 7: Page 7 Last para of Introduction, mention is made of the review drawing on accounting literature - it might be useful to say what that literature provides in terms of the key categories to classify methods?

This is an insightful suggestion, thank you. We have adjusted the sentence you reference to clarify that we apply the category definitions. The sentence now reads as follows: "This comprehensive review draws on management accounting literature [24] 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." To limit the length of the introduction (a concern that reviewer 2 had), we do not mention every possible category. We also describe the key categories earlier in the introduction when we discuss the differences between direct costing and absorption costing in the paragraph 'although...care delivered'. In addressing your next comment, we adopted the same phrasing in the category information bullet point (5th bullet point) under the heading 'eligibility criteria, record selection, and data collection' so that the reader can more easily recognize the underlying logic throughout the paper. See our response to your next comment below for the adjusted phrasing of the bullet point.

Comment 8: Page 8 Two bullet points under Study Eligibility state Cost Measurement method used and the same applied - I am not clear what is the difference here??

Again, this is an excellent question. "Cost measurement method used" refers to the method that authors have applied as described and labelled by the authors verbatim. The "cost measurement method applied" refers to the category of method that we have classified the article into. Our

experience has been that authors use a variety of labels, and that different labels are used for the same methods, which creates confusion. Our goal with this review was to gain clarity by manually categorizing the articles based on management accounting definitions to enable comparisons. Therefore, we state that “The literature contains many overlapping and contradicting terms, as costs can refer to insurer costs, reimbursements, hospital costs, or patient costs.” under the subheading “which cost measurement methods are currently being used to facilitate VBHC?”. This is also why we wrote the note “Studies are classified based on actual costs included and methods described, not necessarily the labels used by authors” under each table in which we report categories.

To be able to compare studies within and across categories, we classified them based on the definitions detailed in the cited accounting literature. We did this by reading the methods section of each paper and, in some cases, appendices, of each study to be able to categorize each study. We provide examples and additional information in the online supplementary appendix.

To improve clarity of the main text and to address your comment, we have adjusted the phrasing of each of the two bullet points you mention in this comment (bullet 4 and 5). They now read as follows:

- 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].

We changed the phrasing to emphasize the fact that we have sorted the studies into categories. We make explicit that the 4th bullet refers to the verbatim label used in the study, and the 5th to the category we have identified the study to belong to using accounting definitions. We hope that this clarifies your question, and we think that this makes clearer to the reader why we chose to categorize the studies. Thank you for this suggestion.

Comment 9: Page 14 The text talks about a first method being direct costing and then in the next paragraph talks about absorption costing which I assume this is the second method and perhaps that should be stated clearly at the beginning of the second para?

These are two broad categories of cost measurement. We have adjusted the phrasing of the second paragraph to highlight that the second category is absorption costing. We added “The second category of studies...” to the start of the paragraph. We also added a brief explanation of the term ‘allocation key’ to further emphasize that this method considers both types of costs. It reads as follows: “...whereby indirect costs are allocated to patients based on an allocation key (a type of formula used for allocating indirect costs) [31].”

Thank you – we think this improves clarity. This way the text is also more easily viewed in conjunction with the tables, and this way it echoes the explanation in the fourth paragraph of the introduction.

Comment 10: Page 20 Line 1 says several studies compared costs calculated with traditional accounting costs or reimbursement - I am not clear what is being said here?

The purpose of this paragraph is to highlight the analyses that the cost calculation methods have enabled. In other words, what authors were able to do with the newly gained information. In this case, some studies used the newly calculated cost information to compare it to other cost calculation methods which authors of the included papers often label “traditional accounting” methods. These include, for example, cost amounts calculated with a DRG system (diagnosis-related group) which are inadequate for value assessments because they do not consider patient level variation and can be the result of hospital-insurer negotiations. The studies we cite here compared the newly calculated costs with cost amounts calculated with old systems, or with reimbursement amounts, and often found large disparities indicating the inaccuracy of some of these older methods. However, as these methods are still in use today, we try to emphasize the urgency of more accurate cost measurement.

Comment 11: Page 20 second para - last line says "Both studies found costs to be unrelated to patient-reported outcome measures" This seems to be an important statement which could do with more explanation?

Indeed, this is an interesting finding. To address your comment, we have expanded on this paragraph and added an explanation of the relevance and potential implications of this finding. We kept this brief (37 words) because we only found two studies reporting this, but we mention the need for future research. Specifically, we added the following explanation: "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 for example their perceived experience with their healthcare professionals."

This suggestion for future research also clarifies the 5th paragraph in our discussion, where we state that future research should focus on comparing costs to outcome measures. Thank you for this suggestion.

Reviewer 2- Dr. Marijke Olthof, University of Groningen

Dear Dr. Olthof,

Thank you for taking the time to review our manuscript and for supplying us with valuable feedback. We also thank you for the positive feedback regarding answering the research questions thoroughly. We understand that, overall, your comments address the clarity and quality of the English, and the length of the introduction. To address this, we have enlisted a professional copyeditor, so you will notice many small adjustments throughout the entire manuscript. We instructed the copyeditor to correct and clarify where possible without changing the argumentation or overall order of paragraphs.

Comment 1: Please pay attention to the English used: there are quite some grammatical issues and typo's

Thank you for pointing this out, reviewer 1 made a similar comment. We have enlisted a professional copyeditor to assist us with improving the English and overall clarity, also taking into consideration the editor's request.

Comment 2: Introduction: Porter's value equation and the triple aim require more explanation

Thank you for this comment – we agree that the term 'value equation' requires explanation. Where possible, we have tried to keep explanations brief in the introduction, but in this case, we were too brief. To limit the number of topics we address (your third comment) we removed the mention of the triple aim from this paragraph and added an explanation of the theoretical underpinning of the value equation. Given that the introduction is already quite long as you mention, we chose to limit this to one sentence. This reads as follows: "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]."

We believe that this provides the reader with the necessary background information to understand the motivation of this study without introducing any terms that are unnecessary.

Comment 3: Quite long introduction: appears to be addressing too many subjects. The alinea "considerable ... costs" could be left out. The alinea "Though ... delivered" could also be shortened. I'm pleased with the explanation and analysis of the difference between actual hospital costs and reimbursements.

Thank you for this positive feedback and your suggestion –We recognize that the introduction is long and covers many topics due to the size of the review. However, from presenting the study internally and at conferences we noticed that it is important to discuss the difference between costs and prices (like you mention), and the fact that patient outcomes have received greater attention in literature than costs. For these reasons, we chose not to remove the paragraph 'considerable ... costs' because this would remove the explanations that motivates the final sentence "Reimbursements are therefore considered a poor indicator of costs". However, we removed the mention of the triple aim (see our

response to your second comment) and we have shortened the previous paragraph by removing the sentence "This is of relevance to hospital administrators and managers facing complex decisions under considerable financial pressures". We have also removed the explanation of process mapping to streamline the introduction and to avoid mentioning too many topics. More specifically, we removed "One step in this method, called 'process mapping', presents care paths visually in a flowchart". Following your helpful suggestion, we have shortened the paragraph "Though ... delivered" by rephrasing sentences and removing the mention of the Da Vinci robot. Our copyeditor also helped reduce the number of words used in this paragraph by replacing lengthy phrasing with simpler words. Specifically, "exist on a continuum from" was replaced by "range from", and "do not consider" was replaced with "ignore". This has shortened the paragraph without removing the cost category information that reviewer 1 found important.

We hope that this addresses your concerns about the length of the introduction and the number of topics mentioned, and we think that this clarifies the motivation of the study. Thank you for this suggestion.

## Conclusion

To conclude, we have discussed and addressed the comments you have provided us with. The comments mostly addressed the clarity of the manuscript, and the quality of English. To address the English, we have enlisted a professional copyeditor, which is why the marked-up manuscript contains many edits. Where possible, we have adopted the suggested phrasing provided by both reviewers. We thank both reviewers for their time and their insightful comments. Should there be any other concerns we look forward to hearing from you.