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## Quality indicators for in-hospital geriatric co-management programmes: a systematic literature review and international Delphi study

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3 **Quality indicators for in-hospital geriatric co-management programmes: a systematic**  
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5 **literature review and international Delphi study**  
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## ABSTRACT

**Objective:** To find consensus on appropriate and feasible structure, process and outcome indicators for the evaluation of in-hospital geriatric co-management programmes.

**Design:** An international two-round Delphi study based on a systematic literature review (searching databases, reference lists, prospective citations and trial registers).

**Setting:** Western Europe and United States.

**Participants:** Thirty-three people with at least two years of clinical experience in geriatric co-management were recruited. Twenty-eight experts (16 from the USA and 12 from Europe) participated in both Delphi rounds (85% response rate).

**Measures:** Participants rated the indicators on a 9-point scale for their A) appropriateness and B) feasibility to use the indicator for the evaluation of geriatric co-management programmes. Indicators were considered appropriate and feasible based on a median score of 7 or higher. Consensus was based on the level of agreement using the RAND/UCLA appropriateness method.

**Results:** In the first round containing 37 indicators there was consensus on 14 indicators. In the second round containing 44 indicators there was consensus on 31 indicators (structure = 8, process = 7, outcome = 16). Experts indicated that co-management should start within 24 hours of hospital admission using defined criteria for selecting appropriate patients. Programmes should focus on the prevention and management of geriatric syndromes and complications. Key areas for comprehensive geriatric assessment included cognition/delirium, functionality/mobility, falls, pain, medication, and pressure ulcers. Key outcomes for evaluating the program included length of stay, time to surgery and the incidence of complications.

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3 **Conclusion:** The indicators can be used to assess the performance of geriatric co-  
4 management programmes and identify areas for improvement. Furthermore, the indicators  
5 can be used to monitor the implementation and effect of these programmes.  
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10 **Key words:** co-management, delphi, evaluation, geriatric medicine, quality, implementation  
11

## 12 13 14 15 16 **STRENGTHS AND LIMITATIONS OF THE STUDY**

### 17 18 19 **Strengths**

- 20 • Preliminary list of indicators developed based on a systematic literature review.
- 21 • Inclusion of experts from both Europe and the United States.
- 22 • Use of RAND/UCLA appropriateness method.

### 23 24 25 26 27 28 29 **Limitations**

- 30 • Sample of experts consisted largely of geriatricians, low number of non-medical  
31 professionals.
- 32 • Lack of empirical evidence supporting the indicators.

## INTRODUCTION

Geriatric co-management programmes are emerging as a potential strategy to manage frail patients on non-geriatrics wards. These programmes are characterized by shared decision making and collaboration between non-geriatrics and geriatrics teams focusing on the prevention and management of geriatric-oriented problems and syndromes.[1] A promising aspect of this model is that geriatrics teams are directly involved in and have direct control over relevant medical issues, which is associated with improved effectiveness of the comprehensive geriatric assessment approach.[2 3] Comprehensive geriatric assessment, a central component in geriatric co-management, is defined as a “multidimensional, interdisciplinary diagnostic process to determine the medical, psychological and functional capabilities of an older person with frailty, followed by the implementation of a coordinated and integrated plan for treatment and follow-up”.[4]

A recent systematic review identified a potential effect on better functional status, prevention of complications and reduced length of stay as a result of geriatric co-management, but the quality of evidence was low.[5] Most notably, the high risk of bias in primary studies and low effect sizes across outcomes limited strong conclusions. Furthermore, the majority of studies were limited to effect evaluations in orthogeriatric populations, while process evaluations and qualitative data are needed to inform how co-management works and how it should be implemented.

Despite the low level of evidence, co-management programmes are increasingly being implemented [6] due to their high face validity and the limited impact of in-hospital geriatric consultation teams. [1 7] However, some knowledge gaps remain. First, there is no evidence-based understanding of core interventions that should be implemented for all co-

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3 management programmes to have their desired effect.[8] Second, there is no framework  
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5 including both effect and process outcomes for evaluating co-management programmes.[9]  
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7 Indicators can inform how to organise in-hospital geriatric co-management programmes,  
8  
9 detail the interventions that have to be implemented and define which components of the  
10  
11 programme and its implementation that have to be evaluated.[10] Structure indicators refer  
12  
13 to “health system characteristics that affect the system’s ability to meet the health care  
14  
15 needs of individual patients or a community”. Process indicators refer to “what the provider  
16  
17 did for the patient and how well it was done”. Outcome indicators refer to “states of health  
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19 or events that follow care and that may be affected by health care”.[10]  
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24 In the absence of systematic evidence on how to organise and evaluate geriatric co-  
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26 management programmes, expert opinion can be a first step to address this evidence  
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28 gap.[11] We therefore aimed to find consensus on structure, process and outcome  
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30 indicators that are appropriate and feasible to use for the implementation and evaluation of  
31  
32 geriatric co-management programmes.  
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## 35 **METHODS**

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37  
38 A two-round Delphi study based on a systematic literature review was performed including  
39  
40 international experts on geriatric co-management. A Delphi study involves several survey  
41  
42 rounds in which experts are asked to answer a questionnaire anonymously. Results can  
43  
44 include both quantitative data (e.g. rating indicators on a numeric scale) and qualitative  
45  
46 data (e.g. comments explaining the rating or suggestions for new indicators) and these  
47  
48 results are reported back to the participants. This iterative process aims to find group  
49  
50 consensus in which participants can change their rating based on the feedback of previous  
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52 survey rounds.[11]  
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3 The first Delphi round was performed from December 2015 to January 2016; the second  
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5 round from February to March 2016.  
6

### 7 8 **Systematic literature review**

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10 A review protocol was registered in the PROSPERO database (CRD42015026033),[12] and  
11  
12 the methodology has been detailed elsewhere.[5] We searched databases (MEDLINE,  
13  
14 EMBASE, CINAHL and CENTRAL), reference lists, trial registers and Pubmed Central Citations  
15  
16 from inception until October 2015. Evaluation studies were included if they reported at least  
17  
18 one structure, process or outcome of an in-hospital geriatric co-management programme.  
19  
20 Two investigators performed the selection process independently using Endnote and data  
21  
22 was tabulated using standardized forms. Discrepancies were resolved using consensus  
23  
24 discussion. Data was structured using the Donabedian model of the three dimensions of  
25  
26 care: structure, process and outcomes (see introduction for definitions).[13]  
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### 31 **Selection of participants**

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33 Participants were required to have a minimum of two years of clinical experience with co-  
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35 management for geriatric in-hospital patients in Europe or North America. Recruitment  
36  
37 strategies included using our own network, sending e-mail invitations through national  
38  
39 geriatrics societies, contacting authors that have published or presented on geriatric co-  
40  
41 management, and contacting members of special interest groups on geriatric co-  
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43 management. Potential participants were contacted via e-mail, asked to complete their  
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45 demographic (name, age, gender, country, state) and professional (affiliation, professional  
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47 education) information, and to report their experience with co-management. The final  
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49 participants were purposively selected with an aim to achieve a balanced sample based on  
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3 profession, experience, gender, age, and region. All participants were offered the  
4 opportunity to receive a voluntary reimbursement for their participation.  
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### 7 **Developing the Delphi questionnaire**

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10 A preliminary set of indicators was drafted based on the systematic literature review. First, a  
11 long list of quality indicators was drafted, structured according to their typology (i.e.  
12 pertaining to the structure, process or outcome of co-management programmes) and  
13 duplicates were removed. Two investigators experienced in geriatric research (BVG, MD)  
14 independently scored these indicators as 'relevant', 'relevant after rephrasing' or 'not  
15 relevant' for inclusion in the Delphi questionnaire. A consensus meeting decided which  
16 indicators were included and how indicators were rephrased. A questionnaire was drafted in  
17 English and piloted by four independent experts (KF, KM, JF, MD) in geriatric research and  
18 medicine (who did not participate in the Delphi rounds) to evaluate the face and content  
19 validity. A consensus meeting between investigators (BVG, KM, JF, MD) decided the final  
20 inclusion of indicators in the Delphi questionnaire.  
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### 35 **Finding consensus among participants (Delphi rounds)**

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38 Participants were contacted via an e-mail explaining the aim and procedure of the Delphi  
39 study. In round one, participants were asked to rate the indicators on a 9-point scale for  
40 their A) appropriateness and B) feasibility to use the indicator for the evaluation of geriatric  
41 co-management programmes. If implemented, appropriate indicators are likely to provide a  
42 net benefit to patients and improve patient outcomes.[14] Feasibility refers to the  
43 measurement of the indicator in clinical practice (and not the feasibility of implementing the  
44 indicator). Participants could suggest additional indicators based on their experience and  
45 knowledge. These suggested indicators were reviewed by the researchers for their  
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3 relevance and included in the second round questionnaire based on a group consensus. In  
4  
5 round two, participants were presented with quantitative and qualitative feedback on the  
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7 rating of the indicators using summary statistics at the group level and anonymous  
8  
9 qualitative quotes by individual participants. Participants were again asked to rate the  
10  
11 appropriateness and feasibility of the indicators for which there was no consensus after  
12  
13 round one and the new indicators suggested by the participants. For both rounds, reminders  
14  
15 were sent to participants.  
16  
17

## 18 **Analysis**

19  
20 Descriptive statistics were used to report the structure, processes and outcomes identified  
21  
22 in the literature and participants' characteristics and their rating of the indicators. Indicators  
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24 were considered appropriate and feasible based on a median score of 7 or higher.  
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26 Consensus was based on the level of agreement using the RAND/UCLA appropriateness  
27  
28 method.<sup>[15]</sup> In short, agreement is observed if the interpercentile range is smaller than the  
29  
30 interpercentile range adjusted for asymmetry. We explored descriptive differences in the  
31  
32 level of agreement between experts from the United States and Europe. Data was analysed  
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34 using SPSS version 20 (SPSS, Chicago, IL, USA).  
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## 40 **RESULTS**

### 41 **Systematic literature review**

42  
43 A total of 39 programmes were identified in 44 publications.<sup>[16-59]</sup> The majority of  
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45 programmes included hip fracture or orthopaedic patients (87%),<sup>[16-19 21-29 31-37 39-49</sup>  
46  
47 52-59] (see Supplementary Table S1) including patients aged 65 years or older (74%)<sup>[16-20</sup>  
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49 23-27 31-36 38 39 42 43 47-51 53 55-59] (see table 1). Only a minority of programmes used  
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51 care pathways (38%),<sup>[16 17 19 20 22 23 25 26 29 32 37-40 42 43 45 48 53]</sup> protocols  
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(33%),[22-26 29 30 33 34 37-40 48 49 53] standard order sets (21%),[19 25 26 29 37 40 42 48 49 53] or educational sessions (15%) [20 29 36 39 40 48 59] to support their implementation. The majority of programmes integrated medical review (71%),[16-21 23-27 29 30 32 35-42 44-46 48-53 56] discharge planning (69%),[18 20 23 24 27-31 33-40 42 45 47-54 56 59] and rehabilitation (77%) [16-21 23 24 27-32 35-40 42 45 47-56 59] as intervention components (see table 2). Daily follow-up was provided in 58% of the programmes,[16 17 23 25 26 29 32-34 36 37 40 42 46 48-51 53 56] and 44% participated in multidisciplinary team meetings.[18-21 23-26 31 36 37 41 50-52 54 56 59] The five most reported outcomes were length of stay, survival, discharge disposition and post-discharge residential status, time to surgery and complications (see figure 1).

**Table 1. Structures identified in co-management programmes**

Structure of co-management programmes	Reported by programmes
Patient population of interest	
- Surgical	34/39 (87%)
- Medical	4/39 (10%)
- Hospital wide	1/39 (3%)
Team composition	
- Geriatrician	38/39 (97%)
- Geriatric nurse	8/39 (21%)
- Physical therapist	25/39 (64%)
- Occupational therapist	14/39 (36%)

- Social worker 19/39 (49%)

#### Patient selection for co-management

##### - Age based characteristics

1. Age < 65 years 10/39 (26%)

2. Age ≥ 65 years 18/39 (46%)

3. Age ≥ 70 years 5/39 (13%)

4. Age ≥ 75 years 3/39 (8%)

##### - Geriatric based characteristics

1. Functional or cognitive impairment 2/39 (5%)

2. Multimorbidity, polypharmacy 1/39 (3%)

- Screening tool 2/39 (5%)

Program defined in a care pathway 15/39 (38%)

Evidence-based protocols available 13/39 (33%)

Standard geriatric order sets available 8/39 (21%)

Organization of educational sessions 6/39 (15%)

**Table 2. Processes identified in co-management programmes**

Processes of co-management programs	Reported by programmes
In-hospital follow-up	26/39 (67%) *
- Daily	15/26 (58%)

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2		
3	- Trice weekly	3/26 (12%)
4		
5		
6	- Twice weekly	3/26 (12%)
7		
8		
9	- Weekly or on request	4/26 (15%)
10		
11	Participation in team meetings	17/39 (44%)
12		
13		
14	- Daily	2/17 (12%)
15		
16		
17	- Trice weekly	1/17 (6%)
18		
19		
20	- Twice weekly	2/17 (12%)
21		
22		
23	- Weekly	12/17 (71%)
24		
25	Medical review/assessment	28/39 (72%)
26		
27		
28	- Cognition	11/28 (39%)
29		
30		
31	- Functional status	13/28 (46%)
32		
33		
34	- Falls	9/28 (32%)
35		
36		
37	- Medication	4/28 (14%)
38		
39		
40	- Nutritional status	5/28 (18%)
41		
42		
43	- Complications	13/28 (46%)
44		
45	Rehabilitation	30/39 (77%)
46		
47		
48	Discharge planning	27/39 (69%)
49		
50		
51	Transitional care	1/39 (3%)
52		
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54	Post-discharge follow-up	16/39 (41%)
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- Referral to community services or outpatient clinics 9/16 (56%)

- Home visit 5/16 (31%)

- Telephone contact 2/16 (13%)

\* There is 1 missing data: study reported 'rounds with staff' but did not indicate the frequency.

### Delphi study

A total of 63 individuals expressed their interest to participate. Based on a purposive selection of participants, 33 experts were selected, 16 from the United States and 17 from Europe. The majority of participants were medical doctors specialized in geriatric medicine having both clinical and academic experience in co-management (see table 3). Only 4 nurses and 1 manager could be included. Participants had a median of 5 years of experience with geriatric co-management, ranging between 2 and 20 years.

**Table 3. Characteristics of participants in Delphi study**

Characteristics	Total Sample	United States	Europe
Response rate, n (%)			
- Round 1	30/33 (91)	16/16 (100)	14/17 (82)
- Round 2	28/33 (85)	16/16 (100)	12/17 (71)
Age, median years (range)	43 (32 – 62)	40.5 (32 – 51)	46.5 (34 – 62)
Female gender, n (%)	16/30 (53)	9/16 (56)	7/14 (50)
Professional education, n (%)			

- Medicine	25/30 (83)	15/16 (94)	10/14 (71)
1. Geriatric medicine	23/30 (77)	13/16 (81)	10/14 (71)
2. Medical doctor	1/30 (3)	1/16 (6)	0
3. Orthopedic surgeon	1/30 (3)	1/16 (6)	0
- Nursing	4/30(13)	0	4/14 (29)
- Management	1/30 (3)	1/16 (6)	0
Academic position, n (%)			
- Professor	6/30 (20)	3/16 (19)	3/14 (21)
- Research associate	1/30 (3)	0	1/14 (7)
- Postdoctoral fellow	2/30 (7)	0	2/14 (14)
- Doctoral student	1/30 (3)	0	1/14 (7)
- Clinical instructor	13/30 (43)	12/16 (75)	1/14 (7)
- No academic position	7/30 (23)	1/16 (6)	6/14 (43)
Co-management background, n (%)			
- Clinical	29/30 (97)	16/16 (100)	13/14 (93)
- Academic	22/30 (73)	12/16 (75)	10/14 (71)
Median years of experience with co-management (range)	5 (2 – 20)	4.5 (2 – 15)	8.5 (2 – 20)

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3 The first round contained 37 indicators. There was consensus on 14 indicators, partial  
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5 consensus on 14 indicators and no consensus on 5 indicators based on a 90.9% response  
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7 rate (n = 30 experts). Based on the qualitative responses, 4 indicators were removed and 11  
8  
9 new indicators were added to the questionnaire. The second round contained 44 indicators  
10  
11 and was sent to the 30 responders of round 1. A final consensus on 31 indicators was  
12  
13 observed based on an overall response rate of 84.8% (n = 28 experts) (see figure 2).  
14  
15

### 16 17 **Structure indicators**

18  
19 All 8 structure indicators were considered appropriate and feasible (see table 4). Geriatric  
20  
21 co-management programmes should include at least a geriatrician, treating physician of the  
22  
23 ward, registered nurse or nurse practitioner with geriatric expertise, nursing staff of the  
24  
25 ward, physical therapist, occupational therapist and social worker. At least one geriatrics  
26  
27 team member should be available on a daily basis. The roles and responsibilities of all  
28  
29 professionals participating in the program should be defined in a care pathway, and their  
30  
31 work should be supported by geriatrics order sets and evidence-based protocols for the  
32  
33 prevention and management of geriatric syndromes. A screening tool or criteria should be  
34  
35 available for including patients into the program. A geriatrics education program should be  
36  
37 available for all new healthcare professionals at induction, and could be repeated yearly for  
38  
39 all professionals participating in the co-management program. Lastly, team meetings should  
40  
41 be organised for reviewing the performance of the program and formulating strategic  
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43 improvement plans.  
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49 Experts from Europe did consider that using geriatric order sets was appropriate but there  
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51 was no consensus within this subgroup.  
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**Table 4. Structure indicators for geriatric co-management programmes**

Indicators	Median Score (IQR)	
	<i>Appr</i>	<i>Feas</i>
<i>All structure indicators were appropriate and feasible<sup>a</sup></i>		
A geriatrician, treating physician of the ward, registered nurse or nurse practitioner with geriatric expertise, nursing staff of the ward, physical therapist, occupational therapist and social worker/discharge or case manager is a core member of the geriatric co-management programme.	7.8 (1.5) <sup>b</sup>	8 (2)
A member of the geriatric team is available on a daily basis for patients included in the geriatric co-management programme.	8 (1)	8 (1.8)
Team meetings for reviewing the performance on indicators associated with the geriatric co-management programme are organized at least once yearly with the aim of evaluating the current performance and formulating strategic improvement plans.	8 (1)	8 (1)
An educational program or sessions are organized or facilitated at induction of every new staff member, and at least once a year for all current hospital staff participating in a geriatric co-management programme, focusing on the identification and management of geriatric syndromes.	8 (2)	8 (2)
A validated screening tool or objective criteria to select patients for the geriatric co-management programme is available to all hospital staff.	8.5 (1)	8 (2.8)

A multidisciplinary care pathway is available detailing the roles and responsibilities of all hospital staff participating in the geriatric co-management programme.	9 (1)	8 (1.8)
Evidence-based protocols for the prevention and/or management of <i>cognitive impairment, delirium, depression, hospital-acquired infections, pressure ulcers, incontinence, urinary retention, constipation, pain, palliative care, polypharmacy, malnutrition, falls, osteoporosis, sleep deprivation, functional impairment/mobility and frailty</i> are available to hospital staff participating in the geriatric co-management programme.	8.3 (1.6) <sup>b</sup>	8 (1)
Standard geriatric order sets (e.g. labs, technical investigations) are available to hospital staff participating in the geriatric co-management programme.	9 (3)	8 (1)

Abbreviations: Appr = Appropriateness; Feas = Feasibility; IQR = Interquartile Range;

<sup>a</sup> Appropriateness and feasibility was determined by a disagreement index: see appendix for all indicators that were considered not appropriate or feasible; <sup>b</sup> scores have been averaged for all response options (see text in italic for the different response options): see appendix for the raw scores;

### Process indicators

Seven out of 12 process indicators were considered appropriate and feasible (see Table 5). Two indicators were also appropriate but not feasible. Geriatric co-management programmes should start preoperatively or within 24 hours of hospital admission, followed by a geriatric assessment also within 24 hours of hospital admission. A member of the geriatrics team should perform daily patient rounds to see patients in the program if

indicated, and interdisciplinary meetings with the co-management staff should be organised at least twice a week. Patients should have their care preferences documented in an advance care plan and should have a discharge plan documented in their patient record. On hospital discharge, a summary of the hospital care and post-discharge instruction should be sent to the primary care practitioner and/or care facility.

Experts from the United States agreed that verbally communicating the findings of the geriatric assessment, recommendations and care plan to other professionals in the co-management program is both appropriate and feasible. Experts from Europe considered this appropriate, but not feasible.

**Table 5. Process indicators for geriatric co-management programmes**

Indicators	Median Score (IQR)	
<i>Process Indicators considered appropriate and feasible with agreement<sup>a</sup></i>	<b>Appr</b>	<b>Feas</b>
For patients included in the geriatric co-man program, co-management starts preoperatively or within 24 hours of hospital admission.	9 (1)	8 (2)
Daily patient rounds are performed by a member of the geriatric team participating in the geriatric co-management programme.	8 (1)	8 (1)
Collaborative interdisciplinary meetings with the primary treating hospital staff participating in the geriatric co-management programme and a member of the geriatric team are organized to discuss patients included in the geriatric co-management	7 (1)	8 (2)

programme at least twice a week.

Percentage of patients included in the geriatric co-management programme who had a screening or assessment focusing on <i>delirium, dementia, functional status, fall risk, social aspects and environment, comorbidity, pressure ulcer risk, pain, nutritional status, incontinence, urinary tract infection, bowel movement, hearing, vision, sleeping disorder, medication use, frailty and advanced care plans</i> using a validated tool within 24 hours of hospital admission.	8.5 (1.6) <sup>b</sup>	8 (1.8)
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Percentage of patients included in the geriatric co-management programme who had their care preferences documented in an advance care plan or advanced directive.	9 (1)	8 (1.8)
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Percentage of patients included in the geriatric co-management programme who have a discharge plan documented in their patient record.	9 (0.3)	8 (1)
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Percentage of patients included in the geriatric co-management programme who have a summary of their hospital care and post-discharge instructions send to their primary care practitioner and/or care facility.	9 (0)	8 (2)
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Abbreviations: Appr = Appropriateness; Feas = Feasibility; IQR = Interquartile Range;

a Appropriateness and feasibility was determined by a disagreement index: see appendix for all indicators that were considered not

appropriate or feasible; <sup>b</sup> scores have been averaged for all response options (see text in italic for the different response options): see

appendix for the raw scores;

### Outcome indicators

Sixteen out of 24 outcome indicators were considered appropriate and feasible (see table 6). Five indicators were also appropriate but not feasible. The highest scoring outcome indicators were length of stay, time from admission to surgery, patient satisfaction with hospital care, institutionalisation and the incidence of delirium and wound infections.

Experts from Europe did consider that length of stay was appropriate, and monitoring physical restraints was feasible, but the level of agreement was insufficient to indicate consensus.

**Table 6. Outcome indicators for geriatric co-management programmes**

Indicators	Median Score (IQR)	
	<i>Appr</i>	<i>Feas</i>
<i>Indicators considered appropriate and feasible with agreement<sup>a, b</sup></i>		
Mean length of stay in the hospital.	9 (1.3)	9 (1)
Mean time spent in the emergency department. <sup>c</sup>	7 (3)	8 (2)
Mean time from hospital admission to surgery. <sup>d</sup>	9 (1.5)	9 (1.3)
Readmission rate within 30 days and three months of hospital discharge.	8 (2) <sup>e</sup>	8 (2)
Patient satisfaction with hospital care.	9 (1)	7 (3)
Caregiver satisfaction with hospital care provided for patients included in the geriatric co-man program.	8.5 (2)	7 (3)
Percentage of patients who were physically restrained during their hospital stay.	9 (2)	8 (3)

In-hospital mortality rate.	9 (2)	9 (0.3)
Percentage of patients admitted to a nursing home on hospital discharge.	9 (1)	9 (1)
Percentage of patients who declined in functional status between hospital admission and hospital discharge.	8 (2)	7 (3)
Percentage of patients who developed delirium.	9 (1)	8 (2)
Percentage of patients who developed a urinary tract infection.	9 (2)	9 (2)
Percentage of patients who developed a wound infection.	9 (1.3)	9 (1.3)
Percentage of patients who developed a pneumonia.	9 (2)	8 (2)
Percentage of patients who developed a sepsis.	9 (2.3)	9 (2)
Percentage of patients who developed a pressure ulcers.	9 (2)	8 (2)

Abbreviations: Appr = Appropriateness; Feas = Feasibility; IQR = Interquartile Range;

<sup>a</sup> Appropriateness and feasibility was determined by a disagreement index: see appendix for all scores; <sup>b</sup> The denominator relates to patients admitted in the co-management program; <sup>c</sup> the denominator only includes patients admitted through the emergency department; <sup>d</sup> the denominator only includes patient included in a surgical co-management program; <sup>e</sup> scores have been averaged for all response options (see text in *italic* for the different response options): see appendix for the raw scores

Supplementary Table S2 details the results for all indicators, including those considered not appropriate or feasible or indicators without consensus.

## DISCUSSION

This study aimed to find consensus on structure, process and outcome indicators that are appropriate and feasible to use for the implementation and evaluation of geriatric co-management programmes using a two-round Delphi study and systematic literature review.

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3 We included 33 participants from Europe and North America and observed consensus on 31  
4 indicators that are considered both appropriate and feasible.  
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7 Experts indicated the importance of providing proactive care to frail patients by geriatric  
8 care professionals within 24 hours of hospital admission. A central focus of these  
9 programmes is the comprehensive geriatric assessment aiming to identify, prevent or  
10 manage geriatric syndromes and complications. There was a strong consensus that co-  
11 management should focus on areas related to delirium, functional status, falls, pressure  
12 ulcers, medication use, comorbidity, nutrition, pain, advance care planning and discharge  
13 planning and its communication.  
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15  
16 The ability of comprehensive geriatric assessment to improve outcomes has been associated  
17 with the ability to implement the treatment plan by the multidisciplinary team.[3] There  
18 was a strong consensus that co-management programmes should be multidisciplinary and  
19 include a geriatrician, treating physician of the non-geriatric ward, a nurse with geriatrics  
20 expertise, physical therapist and social worker. There seems a value for daily co-  
21 management, yet experts argued that the frequency should be based on the severity of a  
22 specific patient case. Nonetheless, this reflects one of the hallmarks of co-management:  
23 shared decision making with daily communication.[60]  
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25  
26 A standard set of outcome parameters for the evaluation of orthogeriatric co-management  
27 programmes was previously developed based on a review of orthogeriatric co-management  
28 evaluation studies,[61] and a consensus development conference.[62] Likewise to our  
29 results, length of stay, time to surgery, incidence of complications, institutionalisation,  
30 readmission rate and mortality were considered important outcomes. However, our Delphi  
31 results disagreed with the panelist of the consensus development conference on post-  
32 discharge follow-up of outcomes, which were generally not considered feasible by our  
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3 experts. Furthermore, the appropriateness of post-discharge follow-up declined the longer  
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5 the endpoint after hospitalization was defined. This indicates that in-hospital co-  
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7 management may not be expected to have long-term effects without appropriate follow-up  
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9 intervention after hospital discharge. Despite long-term follow-up being a key component of  
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11 comprehensive geriatric assessment,[4] this likely reflects a challenge of implementing  
12  
13 transitional care in routine practice as there are often no formal relationships between care  
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15 settings, no financial incentives, inadequate resources and communication, and a lack of  
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17 time.[63]  
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21 Indeed, many effective interventions in healthcare fail to be implemented in practice.[8] Or  
22  
23 alternatively, many routine practices are not (as) effective as defined.[64] The results from  
24  
25 this Delphi study can be used to address this challenge. First, the indicators can be used to  
26  
27 measure the current performance of geriatric co-management programmes and identify  
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29 areas for improvement.[65] Second, the indicators can be used to start a new geriatric co-  
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31 management program. The structure and process indicators can be considered good  
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33 geriatric care for frail patients. However, their implementation should be tailored to the  
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35 local context of the health system, hospital and co-management program. Third, the  
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37 indicators can be used to monitor both the effect and the implementation of the  
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39 program.[66] We therefore advise to monitor both process and outcome indicators when  
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41 evaluating geriatric co-management programmes. This should be a continuous process and  
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43 should be followed by strategic improvement plans and re-evaluations.  
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### 49 **Methodological considerations**

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51 Some considerations should be noted. Firstly, the abstraction of data in the systematic  
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53 literature review was dependent of the quality of reporting in the primary studies, which  
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55 was poor. This may result in underreporting or missing information about particular  
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3 structures and processes. For example, detailed information about the implementation  
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5 strategy or process data on the actual delivery of interventions were missing. Secondly, the  
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7 results are based largely on the views of medical doctors as we could only recruit 4 nurses  
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9 and 1 manager. The indicators may therefore not fully reflect the interdisciplinary nature of  
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11 co-management or the economics of implementing geriatrics care models (e.g. no economic  
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13 indicators have been defined). No patients were included because of the technical nature of  
14  
15 the indicators and the focus on system characteristics. Nonetheless, Patients' views on the  
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17 acceptability of implementing indicators should be considered. If not acceptable, the  
18  
19 indicators will unlikely result in improved outcomes. Thirdly, the results may only be valid  
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21 for North-America and Europe and the validation of the indicators in other countries is  
22  
23 recommended. Fourthly, the observed consensus is based on a specific sample of 33  
24  
25 motivated experts, and it is unclear if the same results would have been produced with a  
26  
27 different sample of experts. However, a systematic review concluded that RAND/UCLA  
28  
29 method has moderate to very good reliability and good construct and predictive validity.[67]  
30  
31 Fifthly, we did not define any threshold standards that should be met when evaluating the  
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33 indicators, and for many indicators these thresholds are not available. Finally, these  
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35 indicators are based on expert opinion in the absence of clinical trial data. The strength of  
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37 the evidence should therefore be considered very low and requires further testing for  
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39 validity and reliability.[14]  
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## 46 **Conclusion**

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49 This Delphi study identified 31 indicators for the evaluation of geriatrics co-management  
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51 programmes. Patient selection, early inclusion, and interdisciplinary care with geriatric  
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53 expertise based on a comprehensive geriatric assessment are considered key elements of  
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55 co-management programmes. The indicators can be used to assess the performance of co-  
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3 management programmes, identify areas for improvement and monitor the implementation  
4  
5 and effect of these programmes. Future research should focus on multicentre studies,  
6  
7 cluster randomization and process evaluation to support the scaling up of effective co-  
8  
9 management programmes.  
10

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38 Geriatric Medicine Society (2016), Lisbon, Portugal.  
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### 41 **Author contributions**

42  
43 All authors (BVG, LM, DAM, SMF, KF, KM, JF, MD) contributed to the study concept and  
44  
45 design. BVG and LM contributed to the acquisition of subjects and/or data. BVG, KM, JF and  
46  
47 MD contributed to the analysis and interpretation of data. All authors (BVG, LM, DAM, SMF,  
48  
49 KF, KM, JF, MD) contributed to the preparation of the manuscript and critically revising it for  
50  
51 important intellectual content. MD supervised this study.  
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### **Competing interests**

DM was co-PI of a John A. Hartford Foundation grant for pilot study to disseminate geriatric co-management programmes (8/2015 – 8/2016). DM is Secretary of the Board of the International Geriatric Fracture Society (IGFS). JF received honoraria for consultancy services to pharmaceutical companies (Pfizer, GSK, SPMSD). All other authors report no potential conflict of interest.

### **Availability of data and materials**

No additional data are available

### **ADDITIONAL FILES**

**Additional file 1:** Supplementary Table S1. Study characteristics systematic literature review.

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3 **Additional file 2:** Supplementary Table S2. Median scores and agreement index for all  
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5 indicators.  
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## FIGURES

### Figure 1. Outcomes reported by co-management programmes

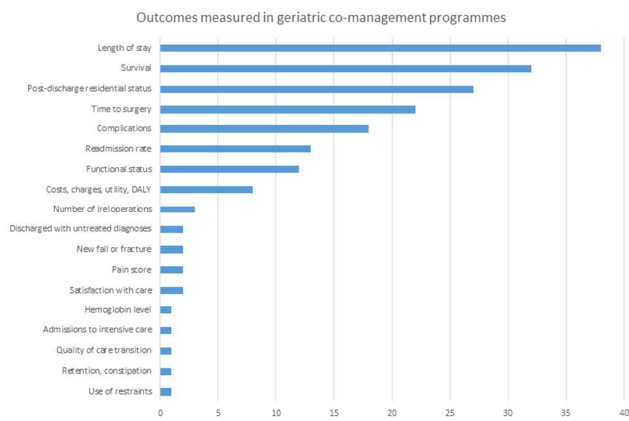
Legend: The bar chart reports the number of programmes reporting a particular outcome.

Abbreviations: DALY = Disability-Adjusted Life Year

### Figure 2. Flowchart of Delphi process

Legend: Consensus was determined based on the level of agreement using the RAND/UCLA appropriateness method. Indicators were rated on a scale of 1 to 9, and considered appropriate and feasible based on a medium score of 7 or higher.

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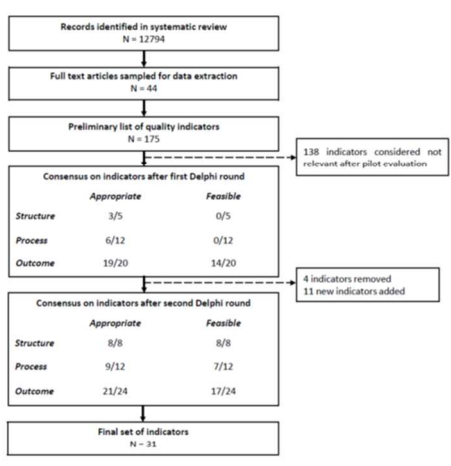


The bar chart reports the number of programmes reporting a particular outcome.  
Abbreviations: DALY = Disability-Adjusted Life Year

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Consensus was determined based on the level of agreement using the RAND/UCLA appropriateness method. Indicators were rated on a scale of 1 to 9, and considered appropriate and feasible based on a medium score of 7 or higher.

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**Supplementary Table S1. Study characteristics systematic literature review**

Study	Country	Design	Population
Adunsky 2003, 2011; Ginsberg 2013 [16 17 32]	Israel	Retrospective cohort study	Hip fracture patients aged 65 years or older
Antonelli Incalzi 1993 [19]	Italy	Before-and-after study with historic cohort	Patients aged 70 years or more admitted to the orthopedic ward
Arbaje 2010 [20]	USA, Maryland	Non randomized controlled trial	Adults 70 years or older admitted on an internal medicine unit
Bhattacharyya 2013 [21]	UK	Retrospective before-and-after study	Hip fracture patients
Biber 2013 [22]	Germany	Before-and-after study with historic cohort	Hip fracture patients aged 60 years and older
Bielza Galindo 2013	Spain	Before-and-after study with historic	Hip fracture patients aged 75 years or older

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[23] cohort

Cogan 2010 [24]	Ireland	Retrospective study	before-and-after	Hip fracture patients
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Elliot 1996 [27]	New Zealand	Retrospective cohort study		Hip fracture patients aged 65 years or older
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Farnworth 1994 [28]	Australia, New South Wales	Retrospective study	before-and-after	Hip fracture patients
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Fisher 2006 [45]	Australia, New South Wales	Before-and-after study with historic cohort		Patients aged 60 years or older with a primary diagnosis of nonpathological hip fracture
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Folbert 2011, 2012 [25 26]	Netherlands	Before-and-after study with historic cohort		Hip fracture patients aged 65 years or older
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Friedman 2009; Kates 2011 [29 40]	USA, New York	Retrospective cohort study		Patients aged 60 years or older admitted for surgical repair of proximal femur fracture
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1 2 3 4 5 6 7 8 9	Germain 1995 [30]	Canada, Quebec	Randomised controlled trial	Functional or mental impaired elderly in-patients
10 11 12	Gilchrist 1988 [31]	UK	Randomised controlled trial	Women with hip fracture aged 65 years or older
13 14 15 16 17	Gregersen 2012 [35]	Denmark	Retrospective before-and-after study	Hip fracture patients aged 65 years or older
18 19 20 21 22	Grund 2015 [36]	Germany	Before-and-after study with historic cohort	Patients with a fracture aged 75 years or older
23 24 25 26 27	Gupta 2014 [37]	UK	Before-and-after study with historic cohort	Hip fracture patients aged 50 years or older
28 29 30	Harari 2007 [39]	UK	Prospective before-and-after study	High-risk medical inpatients aged 70 years or older
31 32 33	Harari 2007 [38]	UK	Prospective before-and-after study	Elective orthopedic patients aged 65 years or older
34 35 36 37 38 39 40 41 42 43 44 45 46 47	Leung 2011 [44]	China	Retrospective before-and-after study	Hip fracture patients aged 60 years or older

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Khan 2002 [41]	UK	Prospective before-and-after study	Elderly patients admitted for fractured femur neck
Khasraghi 2005 [42]	USA, Baltimore (Maryland)	Retrospective before-and-after study	Elderly hip fracture patients
Kristensen 2015 [43]	Denmark	Retrospective cohort study	Hip fracture patients aged 65 years or older
Marsland 2010 [46]	UK	Prospective before-and-after study	Hip fracture patients
Mazzola 2010 [47]	Italy	Prospective cohort study	Hip fracture patients aged 70 years and older
Miura 2009 [48]	USA, Oregon	Before-and-after study with historic cohort	Hip fracture patients aged 55 years or older
Gonzalez-Montalvo 2010, 2011 [33 34]	Spain	Prospective cohort study	Patients with osteoporotic hip fracture aged 65 years or older
Naglie 2002 [49]	Canada, Toronto	RCT	Hip fracture patients aged 70 years or older

Ortiz 2008 [18]	Spain	Before-and-after study with historic cohort	Hip fracture patients aged 65 years or older
Sennour 2009 [50]	USA, Indiana	Retrospective cohort study	Older patients at risk for functional decline
Slaets 1997 [51]	Netherlands	RCT	Medical inpatients aged 75 years or older
Street 1994 [52]	Australia	Before-and-after study with historic cohort	Hip fracture patients aged 50 or older
Suhm 2014 [53]	Switzerland	Prospective before-and-after study	Hip fracture patients aged 65 years or older
Swanson 1998 [54]	Australia, Queensland	Randomised controlled trial	Hip fracture patients aged 55 years or older
Tha 2009 [55]	Australia	Retrospective cohort study	Hip fracture patients aged 65 years or older
Vidan 2005 [56]	Spain	Randomised controlled trial	Patients aged 65 years or older admitted for acute hip fracture surgery
Wagner 2012 [57]	Chile	Before-and-after study with historic cohort	Hip fracture patients aged 65 years or older



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			cohort		
Zeltzer 2014 [58]	Australia,		Multicentre Retrospective		Hip fracture patients aged 65 or older
	New South		cohort study		
	Wales				
Zuckerman 1991 [59]	USA,	New	Retrospective	before-and-after	Hip fracture patients aged 65 years or older
	York		study		

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Supplementary Table S2. Median scores and agreement index for all indicators

Indicator	Median (IQR)		Agreement Index <sup>a</sup>	
	Appropriateness	Feasibility	Appropriateness	Feasibility
<b>Structure indicators</b>				
A(n) ... (see response options below) is a core member of the geriatric co-management program.		8 (2)		-0.6
<i>Geriatrician</i>	9 (0)		0	
<i>Treating physician of the ward</i>	8 (1.3)		-0.3	
<i>Physician assistant</i>	4.2 (3.3)		1.9	
<i>Geriatric nurse practitioner</i>	6.2 (3)		-1.8	
<i>Registered Nurse with geriatric expertise</i>	7 (2)		-0.9	
<i>Registered nurse OR nurse practitioner with geriatric expertise</i>	8 (1)		-0.4	
<i>Nursing staff of the ward</i>	7 (2)		-0.9	
<i>Physical therapist</i>	8 (1)		-0.3	

<i>Occupational therapist</i>	7 (2)		-0.9	
<i>Social worker or discharge of case manager</i>	8 (1)		-0.3	
<i>Dietician</i>	6,5 (2)		10	
<i>Speech therapist</i>	6.5 (3.3)		30	
<i>Pharmacist</i>	7 (2)		-3.1	
A member of the geriatric team is available on a daily basis for patients included in the geriatric co-management program.	8 (1)	8 (2)	-0.3	-0.3
Team meetings for reviewing the performance on indicators associated with the geriatric co-management program are organized at least once yearly with the aim of evaluating the current performance and formulating strategic improvement plans.	8 (1)	8 (1)	-0.3	-0.3
An educational program or sessions are organized or facilitated at induction of every new staff member, and at least once a year for all	8 (2)	8 (2)	-0.3	-0.3

current hospital staff participating in a geriatric co-management program,  
focusing on the identification and management of geriatric syndromes.

A validated screening tool or objective criteria to select patients for the geriatric co-management program is available to all hospital staff.	8.5 (1)	8 (2.8)	-0.3	-0.9
A multidisciplinary care pathway is available detailing the roles and responsibilities of all hospital staff participating in the geriatric co-management program.	9 (1)	8 (1.8)	-0.3	-0.3
Evidence-based protocols for the prevention and/or management of ... (see response options below) are available to hospital staff participating in the geriatric co-management program.		8 (1)		-0.1
<i>Cognitive impairment</i>	9 (1)		-0.3	
<i>Delirium</i>	9 (0)		0	
<i>Depression</i>	7 (2.3)		-0.9	

<i>Hospital-acquired infections</i>	8 (2)	-0.3
<i>Pressure ulcers</i>	9 (1)	-0.3
<i>Incontinence</i>	8 (2)	-0.9
<i>Urinary retention</i>	8 (2)	-0.8
<i>Constipation</i>	8.5 (1)	-0.3
<i>Pain</i>	9 (1)	-0.3
<i>Palliative care</i>	8 (2)	-0.8
<i>Polypharmacy</i>	9 (2)	-0.3
<i>Malnutrition</i>	8 (2)	-0.9
<i>Falls</i>	9 (1)	0
<i>Osteoporosis</i>	8 (2)	-0.9
<i>Sleep deprivation</i>	7 (1.8)	-0.9

<i>Functional impairment/mobility</i>	9 (1)		-0.3	
<i>Frailty</i>	8 (2.8)		-0.9	
Standard geriatric order sets (e.g. labs, technical investigations) are available to hospital staff participating in the geriatric co-management program.	9 (3)	8 (1)	-0.9	-0.3
<b>Process indicators</b>			<b>Appropriateness</b>	<b>Feasibility</b>
For patients included in the geriatric co-management program, co-management starts preoperatively or within 24 hours of hospital admission.	9 (1)	8 (2)	-0.3	-0.3
Mean time spent in the emergency department, of patients included in the geriatric co-management program.	8 (1)	8 (1)	-0.3	-0.3
A member of the geriatric team meets daily with the nurses on the wards participating in the geriatric co-management program.	9 (1)	7 (2)	0	-3.1

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Collaborative interdisciplinary meetings with the primary treating hospital staff participating in the geriatric co-management program and a member of the geriatric team are organized to discuss patients included in the geriatric co-management program at least twice a week.	7 (1)	8 (2)	-0.7	-0.8
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A member of the geriatric team communicates the findings of the geriatric assessment, recommendations and care plans of patients included in the geriatric co-management program verbally with the primary treating hospital staff.	9 (1)	7 (4.8)	-0.3	-7.4
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Percentage of patients eligible for geriatric co-management who were assessed or screened for their eligibility to be included in the geriatric co-management program.	7 (2)	7 (3)	-3.1	-3.1
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Percentage of patients included in the geriatric co-management program who had a screening or assessment focusing on ... (see response options below) using a validated tool within 24 hours of hospital admission.		8 (1.8)		-0.9
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<i>Delirium</i>	9 (1)	-0.3
<i>Dementia</i>	8.5 (2)	-0.3
<i>Depression</i>	6 (3)	-3.1
<i>Functional status</i>	9 (0)	0
<i>Fall risk</i>	9 (1.3)	-0.3
<i>Social aspects and environment</i>	9 (2)	-0.8
<i>Comorbidity</i>	9 (2)	-0.3
<i>Pressure ulcer risk</i>	8.5 (2)	-0.3
<i>Pain</i>	9 (1)	0
<i>Nutritional status</i>	9 (1.3)	-0.3
<i>Incontinence</i>	8 (2)	-0.3
<i>Urinary retention</i>	8 (2)	-0.9



<i>Bowel movement</i>	8 (1.3)		-0.3	
<i>Hearing</i>	8 (2)		-0.9	
<i>Vision</i>	8 (2)		-0.9	
<i>Sleeping disorder</i>	7 (2.5)		-0.9	
<i>Medication use</i>	9 (1)		0	
<i>Dysphagia</i>	7 (3.8)		-2.1	
<i>Frailty</i>	8 (1.8)		-0.7	
<i>(health related) quality of life</i>	6 (4)		30	
<i>Advanced directive/care plan</i>	8,5 (1)		-0.3	
Percentage of patients included in the geriatric co-management program who had their care preferences documented in an advance care plan or advanced directive.	9 (1)	8 (1.8)	-0.3	-0.3
Percentage of patients included in the geriatric co-management program	9 (0.3)	8 (1)	0	-0.3

who have a discharge plan documented in their patient record.

Percentage of patients included in the geriatric co-management program who have a summary of their hospital care and post-discharge instructions send to their primary care practitioner and/or care facility.	9 (0)	8 (2)	0	-0.8
Percentage of patients included in the geriatric co-management program who received post-discharge follow-up from a member of the geriatric team ... (see response options below).	7 (1)	7 (1)	-2.6	-2.6
<i>Within 3 days of hospital discharge</i>	6.5 (6)		-46.1	
<i>Within 5 days of hospital discharge</i>	6.5 (5)		5.4	
<i>Within 7 days of hospital discharge</i>	7 (3.8)		-9.7	
<i>Within 14 days of hospital discharge</i>	7 (3)		-26.6	
If a co-managed patient is discharged to a facility, a member of the geriatric co-management team calls the facility with post-discharge	7 (3)	6 (3.8)	-4.8	2.1

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instructions.				
<b>Outcome indicators</b>	<b>Appropriateness</b>	<b>Feasibility</b>	<b>Appropriateness</b>	<b>Feasibility</b>
Mean length of stay in the hospital, of patients included in the geriatric co-management program.	9 (1.3)	9 (1)	-0.3	-0.3
Daily patient rounds are performed by a member of the geriatric team participating in the geriatric co-management program.	7 (3)	8 (2)	-0.9	-0.3
Mean time from hospital admission to surgery, of surgical patients included in the geriatric co-management program.	9 (1.5)	9 (1.3)	-0.3	-0.3
Readmission rate of patients included in the geriatric co-management program within ... (see response options below).		8 (2)		-0.9
<i>Within 30 days of hospital discharge</i>	9 (1)		-0.3	
<i>Within 3 months of hospital discharge</i>	7 (3)		-0.9	
<i>Within 6 months of hospital discharge</i>	5 (3)		1.9	

<i>Within 1 year of hospital discharge</i>	5 (6.5)		3.3	
Patient satisfaction with hospital care, of patients included in the geriatric co-management program.	9 (1)	7 (3)	-0.3	-0.9
Caregiver satisfaction with hospital care provided for patients included in the geriatric co-management program.	8.5 (2)	7 (3)	-0.3	-0.9
Percentage of patients included in the geriatric co-management program who were physically restrained during their hospital stay.	9 (2)	8 (3)	-0.9	-0.9
In-hospital mortality rate of patients included in the geriatric co-management program.	8 (2)	9 (0.3)	-0.3	0
Post-discharge mortality rate of patients included in the geriatric co-management program ... (see response options below).		7 (3)		30
<i>Within 30 days of hospital discharge</i>	8,5 (2)		-0.3	
<i>Within 3 months of hospital discharge</i>	7 (3.5)		-1.3	

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<i>Within 6 months of hospital discharge</i>	5,5 (3)		-22.6	
<i>Within 1 year of hospital discharge</i>	7 (5)		-6.2	
Percentage of patients included in the geriatric co-management program admitted to a nursing home on hospital discharge.	9 (1)	9 (1)	-0.3	-0.3
Percentage of patients included in the geriatric co-management program admitted to a nursing home <i>post-discharge ... (see response options below).</i>		6 (4.5)		32
<i>Within 30 days of hospital discharge</i>	8 (3)		-0.9	
<i>Within 3 months of hospital discharge</i>	5.5 (2.3)		14.5	
<i>Within 6 months of hospital discharge</i>	5 (3)		0.9	
<i>Within 1 year of hospital discharge</i>	4 (4.5)		1.6	
Percentage of patients included in the geriatric co-management program who declined in functional status between hospital admission and	8 (2)	7 (3)	-0.8	-0.7

hospital discharge.

Percentage of patients included in the geriatric co-management program who declined in cognitive functioning between hospital admission and post-discharge ... (see response options below).		5 (3.5)		1.9
<i>Within 30 days of hospital discharge</i>	8 (2)		-0,3	
<i>Within 3 months of hospital discharge</i>	7 (3)		30	
<i>Within 6 months of hospital discharge</i>	5 (3)		2.3	
<i>Within 1 year of hospital discharge</i>	5 (4.5)		1.7	
Percentage of patients included in the geriatric co-management program who declined in cognitive functioning between hospital admission and hospital discharge.	8 (3)	6.5 (2.5)	-0.9	14.5
Percentage of patients included in the geriatric co-management program who declined in cognitive functioning between hospital admission and		5 (3)		0.9

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post-discharge ... (see response options below).				
Within 30 days of hospital discharge	7 (3)		-1.0	
Within 3 months of hospital discharge	6 (2.3)		2.4	
Within 6 months of hospital discharge	5 (4)		1.7	
Within 1 year of hospital discharge	5 (4)		1.0	
Percentage of patients included in the geriatric co-management program who developed/experienced delirium.	9 (1)	8 (2)	-0.3	-0.8
Percentage of patients included in the geriatric co-management program who developed/experienced an urinary tract infection.	9 (2)	9 (2)	-0.8	-0.8
Percentage of patients included in the geriatric co-management program who developed/experienced a wound infection.	9 (1.3)	9 (1.3)	-0.3	-0.3
Percentage of patients included in the geriatric co-management program who developed/experienced a pneumonia	9 (2)	8 (2)	-0.3	-0.9

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Percentage of patients included in the geriatric co-management program who developed/experienced a sepsis	9 (2.3)	9 (2)	-0.3	-0.3
Percentage of patients included in the geriatric co-management program who developed/experienced a pressure ulcers	9 (2)	8 (2)	-0.3	-0.9
Satisfaction with the co-management service, rated by the treating physician of the ward participating in the geriatric co-management program.	7 (3)	7 (3)	-3.1	-3.1
Satisfaction with the co-management service, rated by the nursing staff of the ward participating in the geriatric co-management program.	7.5 (2)	7 (3)	-0.8	-3.1
Perceived level of support by hospital staff participating in the geriatric co-management program in caring for geriatric patients rated on a numeric scale (0 to 10).	6 (3.5)	6.5 (4.8)	-3.1	8.1

Abbreviations: IQR = interquartile range;

<sup>a</sup> An agreement index score of < 1 indicates consensus between experts. Note: the higher the interquartile range, the higher the agreement index score, and the lower the level of consensus.



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## Quality indicators for in-hospital geriatric co-management programmes: a systematic literature review and international Delphi study

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3 **Quality indicators for in-hospital geriatric co-management programmes: a systematic**  
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5 **literature review and international Delphi study**  
6

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## ABSTRACT

**Objective:** To find consensus on appropriate and feasible structure, process and outcome indicators for the evaluation of in-hospital geriatric co-management programmes.

**Design:** An international two-round Delphi study based on a systematic literature review (searching databases, reference lists, prospective citations and trial registers).

**Setting:** Western Europe and United States.

**Participants:** Thirty-three people with at least two years of clinical experience in geriatric co-management were recruited. Twenty-eight experts (sixteen from the USA and twelve from Europe) participated in both Delphi rounds (85% response rate).

**Measures:** Participants rated the indicators on a nine point scale for their A) appropriateness and B) feasibility to use the indicator for the evaluation of geriatric co-management programmes. Indicators were considered appropriate and feasible based on a median score of seven or higher. Consensus was based on the level of agreement using the RAND/UCLA appropriateness method.

**Results:** In the first round containing 37 indicators there was consensus on fourteen indicators. In the second round containing 44 indicators there was consensus on 31 indicators (structure = eight, process = seven, outcome = sixteen). Experts indicated that co-management should start within 24 hours of hospital admission using defined criteria for selecting appropriate patients. Programmes should focus on the prevention and management of geriatric syndromes and complications. Key areas for comprehensive geriatric assessment included cognition/delirium, functionality/mobility, falls, pain, medication, and pressure ulcers. Key outcomes for evaluating the program included length of stay, time to surgery and the incidence of complications.

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2  
3 **Conclusion:** The indicators can be used to assess the performance of geriatric co-  
4 management programmes and identify areas for improvement. Furthermore, the indicators  
5 can be used to monitor the implementation and effect of these programmes.  
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7  
8

9  
10 **Key words:** co-management, Delphi, evaluation, geriatric medicine, quality, implementation  
11

## 12 13 14 15 16 **STRENGTHS AND LIMITATIONS OF THE STUDY**

### 17 18 19 **Strengths**

- 20 • Preliminary list of indicators developed based on a systematic literature review.
- 21 • Inclusion of experts from both Europe and the United States.
- 22 • Use of RAND/UCLA appropriateness method.

### 23 24 25 26 27 28 29 **Limitations**

- 30 • Sample of experts consisted largely of geriatricians, low number of non-medical  
31 professionals.
- 32 • Lack of empirical evidence supporting the indicators.

## INTRODUCTION

Geriatric co-management programmes are emerging as a potential strategy to manage frail patients on non-geriatrics wards. These programmes are characterized by a shared decision making and collaboration between non-geriatrics and geriatrics teams focusing on the prevention and management of geriatric-oriented problems and syndromes.[1] A promising aspect of this model is that geriatrics teams are directly involved in and have direct control over relevant medical issues, which is associated with improved effectiveness of the comprehensive geriatric assessment approach.[2 3] Comprehensive geriatric assessment, a central component in geriatric co-management, is defined as a “multidimensional, interdisciplinary diagnostic process to determine the medical, psychological and functional capabilities of an older person with frailty, followed by the implementation of a coordinated and integrated plan for treatment and follow-up”.[4]

A recent systematic review identified a potential effect on better functional status, prevention of complications and reduced length of stay as a result of geriatric co-management, but the quality of evidence was low.[5] Most notably, the high risk of bias in primary studies and low effect sizes across outcomes limited strong conclusions. Furthermore, the majority of studies were limited to effect evaluations in orthogeriatric populations, while process evaluations and qualitative data are needed to inform how co-management works and how it should be implemented.

Despite the low level of evidence, co-management programmes are increasingly being implemented [6] due to their high face validity and the limited impact of in-hospital geriatric consultation teams. [1 7] However, some knowledge gaps remain. First, there is no evidence-based understanding of core interventions that should be implemented for all co-

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3 management programmes to have their desired effect.[8] Second, there is no framework  
4  
5 including both effect and process outcomes for evaluating co-management programmes.[9]  
6  
7 Indicators can inform how to organise in-hospital geriatric co-management programmes,  
8  
9 detail the interventions that have to be implemented and define which components of the  
10  
11 programme and its implementation that have to be evaluated.[10] Structure indicators refer  
12  
13 to “health system characteristics that affect the system’s ability to meet the health care  
14  
15 needs of individual patients or a community”. Process indicators refer to “what the provider  
16  
17 did for the patient and how well it was done”. Outcome indicators refer to “states of health  
18  
19 or events that follow care and that may be affected by health care”.[10]  
20  
21  
22  
23

24 In the absence of systematic evidence on how to organise and evaluate geriatric co-  
25  
26 management programmes, expert opinion can be a first step to address this evidence  
27  
28 gap.[11] We therefore aimed to find consensus on structure, process and outcome  
29  
30 indicators that are appropriate and feasible to use for the implementation and evaluation of  
31  
32 geriatric co-management programmes.  
33  
34

## 35 **METHODS**

36  
37  
38 A two-round Delphi study based on a systematic literature review was performed including  
39  
40 international experts on geriatric co-management. A Delphi study involves several survey  
41  
42 rounds in which experts are asked to answer a questionnaire anonymously. Results can  
43  
44 include both quantitative data (e.g. rating indicators on a numeric scale) and qualitative  
45  
46 data (e.g. comments explaining the rating or suggestions for new indicators) and these  
47  
48 results are reported back to the participants. This iterative process aims to find group  
49  
50 consensus in which participants can change their rating based on the feedback of previous  
51  
52 survey rounds.[11]  
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2  
3 The first Delphi round was performed from December 2015 to January 2016; the second  
4  
5 round from February to March 2016.  
6

### 7 **Systematic literature review**

8  
9  
10 The study methodology and search strategy has been detailed elsewhere and is available in  
11  
12 a review protocol in the PROSPERO database (CRD42015026033).[5 12] We searched  
13  
14 databases (MEDLINE, EMBASE, CINAHL and CENTRAL), reference lists, trial registers and  
15  
16 Pubmed Central Citations from inception until October 2015. Evaluation studies were  
17  
18 included if they reported at least one structure, process or outcome of an in-hospital  
19  
20 geriatric co-management programme. Two investigators performed the selection process  
21  
22 independently using Endnote and data was tabulated using standardized forms.  
23  
24 Discrepancies were resolved using consensus discussion. Data was structured using the  
25  
26 Donabedian model of the three dimensions of care: structure, process and outcomes (see  
27  
28 introduction for definitions).[13]  
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### 33 **Selection of participants**

34  
35  
36 Participants were required to have a minimum of two years of clinical experience with co-  
37  
38 management for geriatric in-hospital patients in Europe or North America. Recruitment  
39  
40 strategies included using our own network, sending e-mail invitations through national  
41  
42 geriatrics societies, contacting authors that have published or presented on geriatric co-  
43  
44 management, and contacting members of special interest groups on geriatric co-  
45  
46 management. Potential participants were contacted via e-mail, asked to complete their  
47  
48 demographic (name, age, gender, country, state) and professional (affiliation, professional  
49  
50 education) information, and to report their experience with co-management. The final  
51  
52 participants were purposively selected with an aim to achieve a balanced sample based on  
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3 profession, experience, gender, age, and region. All participants were offered the  
4  
5 opportunity to receive a voluntary reimbursement for their participation.  
6

### 7 8 **Developing the Delphi questionnaire**

9  
10 A preliminary set of indicators was drafted based on the systematic literature review. First, a  
11  
12 long list of quality indicators was drafted, structured according to their typology (i.e.  
13  
14 pertaining to the structure, process or outcome of co-management programmes) and  
15  
16 duplicates were removed. Two investigators experienced in geriatric research (BVG, MD)  
17  
18 independently scored these indicators as 'relevant', 'relevant after rephrasing' or 'not  
19  
20 relevant' for inclusion in the Delphi questionnaire. A consensus meeting decided which  
21  
22 indicators were included and how indicators were rephrased. A questionnaire was drafted in  
23  
24 English and piloted by four independent experts (KF, KM, JF, MD) in geriatric research and  
25  
26 medicine (who did not participate in the Delphi rounds) to evaluate the face and content  
27  
28 validity. A consensus meeting between investigators (BVG, KM, JF, MD) decided the final  
29  
30 inclusion of indicators in the Delphi questionnaire.  
31  
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34

### 35 36 **Finding consensus among participants (Delphi rounds)**

37  
38 Participants were contacted via an e-mail explaining the aim and procedure of the Delphi  
39  
40 study. In round one, participants were asked to rate the indicators on a nine point scale for  
41  
42 their A) appropriateness and B) feasibility to use the indicator for the evaluation of geriatric  
43  
44 co-management programmes. If implemented, appropriate indicators are likely to provide a  
45  
46 net benefit to patients and improve patient outcomes.[14] Feasibility refers to the  
47  
48 measurement of the indicator in clinical practice (and not the feasibility of implementing the  
49  
50 indicator). Participants could suggest additional indicators based on their experience and  
51  
52 knowledge. These suggested indicators were reviewed by the researchers for their  
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1  
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3 relevance and included in the second round questionnaire based on a group consensus. In  
4  
5 round two, participants were presented with quantitative and qualitative feedback on the  
6  
7 rating of the indicators using summary statistics at the group level and anonymous  
8  
9 qualitative quotes by individual participants. Participants were again asked to rate the  
10  
11 appropriateness and feasibility of the indicators for which there was no consensus after  
12  
13 round one and the new indicators suggested by the participants. For both rounds, reminders  
14  
15 were sent to participants.  
16  
17

### 18 19 **Analysis**

20  
21 Descriptive statistics were used to report the structure, processes and outcomes identified  
22  
23 in the literature and participants' characteristics and their rating of the indicators. Indicators  
24  
25 were considered appropriate and feasible based on a median score of seven or higher.  
26  
27 Consensus was based on the level of agreement using the RAND/UCLA appropriateness  
28  
29 method.[15] In short, agreement is observed if the interpercentile range is smaller than the  
30  
31 interpercentile range adjusted for asymmetry. We explored descriptive differences in the  
32  
33 level of agreement between experts from the United States and Europe. Data was analysed  
34  
35 using SPSS version 20 (SPSS, Chicago, IL, USA).  
36  
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### 40 41 **Ethics**

42  
43 All participants consented to participate in the study via e-mail. Approval by a local ethics  
44  
45 committee was not required as a Delphi study with healthcare professionals is not  
46  
47 considered an experiment (Belgian law dated 7<sup>th</sup> May 2004 related to experiments on  
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49 human people).  
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## RESULTS

### Systematic literature review

A total of 12794 titles and abstracts were independently screened by two authors. A total of 335 full text articles were independently assessed for eligibility by two authors. A final 44 manuscripts were included for data extraction. Studies were excluded because they did not report the evaluation of an in-hospital co-management programme (n = 248), were an abstract (n = 66), letter to the editor (n = 6) or published in another language (n = 3)."

A total of 39 programmes were identified in 44 publications.[16-59] The majority of programmes included hip fracture or orthopaedic patients (87%),[16-19 21-29 31-37 39-49 52-59] (see Supplementary Table S1) including patients aged 65 years or older (74%) [16-20 23-27 31-36 38 39 42 43 47-51 53 55-59] (see table 1). Only a minority of programmes used care pathways (38%),[16 17 19 20 22 23 25 26 29 32 37-40 42 43 45 48 53] protocols (33%),[22-26 29 30 33 34 37-40 48 49 53] standard order sets (21%),[19 25 26 29 37 40 42 48 49 53] or educational sessions (15%) [20 29 36 39 40 48 59] to support their implementation. The majority of programmes integrated medical review (71%),[16-21 23-27 29 30 32 35-42 44-46 48-53 56] discharge planning (69%),[18 20 23 24 27-31 33-40 42 45 47-54 56 59] and rehabilitation (77%) [16-21 23 24 27-32 35-40 42 45 47-56 59] as intervention components (see table 2). Daily follow-up was provided in 58% of the programmes,[16 17 23 25 26 29 32-34 36 37 40 42 46 48-51 53 56] and 44% participated in multidisciplinary team meetings.[18-21 23-26 31 36 37 41 50-52 54 56 59] The five most reported outcomes were length of stay, survival, discharge disposition and post-discharge residential status, time to surgery and complications (see figure 1).

**Table 1. Structures identified in co-management programmes**

<b>Structure of co-management programmes</b>	<b>Reported by programmes</b>
<b>Patient population of interest</b>	
- Surgical	34/39 (87%)
- Medical	4/39 (10%)
- Hospital wide	1/39 (3%)
<b>Team composition</b>	
- Geriatrician	38/39 (97%)
- Geriatric nurse	8/39 (21%)
- Physical therapist	25/39 (64%)
- Occupational therapist	14/39 (36%)
- Social worker	19/39 (49%)
<b>Patient selection for co-management</b>	
- Age based characteristics <sup>1</sup>	
1. Age < 65 years <sup>2</sup>	10/39 (26%)
2. Age ≥ 65 years	18/39 (46%)
3. Age ≥ 70 years	5/39 (13%)
4. Age ≥ 75 years	3/39 (8%)
- Geriatric based characteristics	
1. Functional or cognitive impairment	2/39 (5%)

2. Multimorbidity, polypharmacy	1/39 (3%)
- Screening tool	2/39 (5%)
Program defined in a care pathway	15/39 (38%)
Evidence-based protocols available	13/39 (33%)
Standard geriatric order sets available	8/39 (21%)
Organization of educational sessions	6/39 (15%)

<sup>1</sup> Data was missing for 3 studies

<sup>2</sup> The category Age < 65 years refers to studies recruiting patients aged 26 years or older (n = 1), 50 years or older (n = 3), 55 years or older (n = 1), 60 years or older (n = 5).

**Table 2. Processes identified in co-management programmes**

Processes of co-management programmes	Reported by programmes
In-hospital follow-up	26/39 (67%) <sup>1</sup>
- Daily	15/26 (58%)
- Thrice weekly	3/26 (12%)
- Twice weekly	3/26 (12%)
- Weekly or on request	4/26 (15%)
Participation in team meetings <sup>2</sup>	17/39 (44%)
- Daily	2/17 (12%)
- Thrice weekly	1/17 (6%)
- Twice weekly	2/17 (12%)

- Weekly	12/17 (71%)
Medical review/assessment <sup>3</sup>	28/39 (72%)
- Cognition	11/28 (39%)
- Functional status	13/28 (46%)
- Falls	9/28 (32%)
- Medication	4/28 (14%)
- Nutritional status	5/28 (18%)
- Complications	13/28 (46%)
Rehabilitation <sup>4</sup>	30/39 (77%)
Discharge planning	27/39 (69%)
Transitional care <sup>5</sup>	1/39 (3%)
Post-discharge follow-up	16/39 (41%)
- Referral to community services or outpatient clinics	9/16 (56%)
- Home visit	5/16 (31%)
- Telephone contact	2/16 (13%)

<sup>1</sup> There is 1 missing data: study reported 'rounds with staff' but did not indicate the frequency.

<sup>2</sup> Team meetings were defined as case conferences or multidisciplinary meeting in which the geriatrician or geriatrics team interacts with the primary treating physician or other ward staff (e.g. registered nurses, physical therapists) to discuss patients included in the co-management programme.

<sup>3</sup> Medical review was defined as "the prevention of iatrogenic complications through assessment and delivery of interventions that addresses actual or potential problems identified in the assessment".[60]

<sup>4</sup> Rehabilitation was defined as "assessing the need for physical therapy and providing physical and occupational therapy to prevent or reverse functional decline".[60]

<sup>5</sup> Transitional care was defined as “a set of actions designed to ensure the coordination and continuity of health care as patients transfer between different locations or different levels of care in the same location”.<sup>[61]</sup>

## Delphi study

A total of 63 individuals expressed their interest to participate. Based on a purposive selection of participants, 33 experts were selected, sixteen from the United States and seventeen from Europe. The majority of participants were medical doctors specialized in geriatric medicine having both clinical and academic experience in co-management (see table 3). Only four nurses and one manager could be included. Participants had a median of five years of experience with geriatric co-management, ranging between two and twenty years.

**Table 3. Characteristics of participants in Delphi study**

Characteristics	Total Sample	United States	Europe
Response rate, n (%)			
- Round 1	30/33 (91)	16/16 (100)	14/17 (82)
- Round 2	28/33 (85)	16/16 (100)	12/17 (71)
Age, median years (range)	43 (32 – 62)	40.5 (32 – 51)	46.5 (34 – 62)
Female gender, n (%)	16/30 (53)	9/16 (56)	7/14 (50)
Professional education, n (%)			
- Medicine	25/30 (83)	15/16 (94)	10/14 (71)
1. Geriatric medicine	23/30 (77)	13/16 (81)	10/14 (71)

2. Medical doctor	1/30 (3)	1/16 (6)	0
3. Orthopedic surgeon	1/30 (3)	1/16 (6)	0
- Nursing	4/30(13)	0	4/14 (29)
- Management	1/30 (3)	1/16 (6)	0
Academic position, n (%)			
- Professor	6/30 (20)	3/16 (19)	3/14 (21)
- Research associate	1/30 (3)	0	1/14 (7)
- Postdoctoral fellow	2/30 (7)	0	2/14 (14)
- Doctoral student	1/30 (3)	0	1/14 (7)
- Clinical instructor	13/30 (43)	12/16 (75)	1/14 (7)
- No academic position	7/30 (23)	1/16 (6)	6/14 (43)
Co-management background, n (%)			
- Clinical	29/30 (97)	16/16 (100)	13/14 (93)
- Academic	22/30 (73)	12/16 (75)	10/14 (71)
Median years of experience with co-management (range)	5 (2 – 20)	4.5 (2 – 15)	8.5 (2 – 20)

The first round contained 37 indicators. There was consensus on fourteen indicators, partial consensus on fourteen indicators and no consensus on five indicators based on a 90.9% response rate (n = 30 experts). Based on the qualitative responses, four indicators were removed and eleven new indicators were added to the questionnaire (see supplemental

1  
2  
3 tables S2 and S3). These new indicators were suggested by the Delphi participants. The  
4  
5 second round contained 44 indicators and was sent to the 30 responders of round one. A  
6  
7 final consensus on 31 indicators was observed based on an overall response rate of 84.8% (n  
8  
9 = 28 experts) (see figure 2).  
10

### 11 **Structure indicators**

12  
13  
14 All eight structure indicators were considered appropriate and feasible (see table 4).  
15  
16 Geriatric co-management programmes should include at least a geriatrician, treating  
17  
18 physician of the ward, registered nurse or nurse practitioner with geriatric expertise, nursing  
19  
20 staff of the ward, physical therapist, occupational therapist and social worker. At least one  
21  
22 geriatrics team member should be available on a daily basis. The roles and responsibilities of  
23  
24 all professionals participating in the program should be defined in a care pathway, and their  
25  
26 work should be supported by geriatrics order sets and evidence-based protocols for the  
27  
28 prevention and management of geriatric syndromes. A screening tool or criteria should be  
29  
30 available for including patients into the program. A geriatrics education program should be  
31  
32 available for all new healthcare professionals at induction, and could be repeated yearly for  
33  
34 all professionals participating in the co-management program. Lastly, team meetings should  
35  
36 be organised for reviewing the performance of the programme and formulating strategic  
37  
38 improvement plans.  
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45 Experts from Europe did consider that using geriatric order sets was appropriate but there  
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47 was no consensus within this subgroup.  
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**Table 4. Structure indicators for geriatric co-management programmes**

Indicators	Median Score (IQR)	
	<i>Appr</i>	<i>Feas</i>
<i>All structure indicators were appropriate and feasible</i> <sup>1</sup>		
A geriatrician, treating physician of the ward, registered nurse or nurse practitioner with geriatric expertise, nursing staff of the ward, physical therapist, occupational therapist and social worker/discharge or case manager is a core member of the geriatric co-management programme.	7.8 (1.5) <sup>2</sup>	8 (2)
A member of the geriatric team is available on a daily basis for patients included in the geriatric co-management programme.	8 (1)	8 (1.8)
Team meetings for reviewing the performance on indicators associated with the geriatric co-management programme are organised at least once yearly with the aim of evaluating the current performance and formulating strategic improvement plans.	8 (1)	8 (1)
An educational programme or sessions are organised or facilitated at induction of every new staff member, and at least once a year for all current hospital staff participating in a geriatric co-management programme, focusing on the identification and management of geriatric syndromes.	8 (2)	8 (2)
A validated screening tool or objective criteria to select patients for the geriatric co-management programme is available to all hospital staff.	8.5 (1)	8 (2.8)

A multidisciplinary care pathway is available detailing the roles and responsibilities of all hospital staff participating in the geriatric co-management programme.	9 (1)	8 (1.8)
Evidence-based protocols for the prevention and/or management of <i>cognitive impairment, delirium, depression, hospital-acquired infections, pressure ulcers, incontinence, urinary retention, constipation, pain, palliative care, polypharmacy, malnutrition, falls, osteoporosis, sleep deprivation, functional impairment/mobility and frailty</i> are available to hospital staff participating in the geriatric co-management programme.	8.3 (1.6) <sup>2</sup>	8 (1)
Standard geriatric order sets (e.g. labs, technical investigations) are available to hospital staff participating in the geriatric co-management programme.	9 (3)	8 (1)

Abbreviations: Appr = Appropriateness; Feas = Feasibility; IQR = Interquartile Range;

<sup>1</sup> Appropriateness and feasibility was determined by a disagreement index: see appendix for all indicators that were considered not appropriate or feasible; <sup>2</sup> scores have been averaged for all response options (see text in italic for the different response options): see appendix for the raw scores;

### Process indicators

Seven out of twelve process indicators were considered appropriate and feasible (see Table 5). Two indicators were also appropriate but not feasible. Geriatric co-management programmes should start preoperatively or within 24 hours of hospital admission, followed by a geriatric assessment also within 24 hours of hospital admission. A member of the geriatrics team should perform daily patient rounds to see patients in the program if

indicated, and interdisciplinary meetings with the co-management staff should be organised at least twice a week. Patients should have their care preferences documented in an advance care plan and should have a discharge plan documented in their patient record. On hospital discharge, a summary of the hospital care and post-discharge instruction should be sent to the primary care practitioner and/or care facility.

Experts from the United States agreed that verbally communicating the findings of the geriatric assessment, recommendations and care plan to other professionals in the co-management program is both appropriate and feasible. Experts from Europe considered this appropriate, but not feasible.

**Table 5. Process indicators for geriatric co-management programmes**

Indicators	Median Score (IQR)	
<i>Process Indicators considered appropriate and feasible with agreement<sup>1</sup></i>	<b>Appr</b>	<b>Feas</b>
For patients included in the geriatric co-management programme, co-management starts preoperatively or within 24 hours of hospital admission.	9 (1)	8 (2)
Daily patient rounds are performed by a member of the geriatric team participating in the geriatric co-management programme.	8 (1)	8 (1)
Collaborative interdisciplinary meetings with the primary treating hospital staff participating in the geriatric co-management programme and a member of the geriatric team are organised to discuss patients included in the geriatric co-management	7 (1)	8 (2)

programme at least twice a week.

Percentage of patients included in the geriatric co-management programme who had a screening or assessment focusing on <i>delirium, dementia, functional status, fall risk, social aspects and environment, comorbidity, pressure ulcer risk, pain, nutritional status, incontinence, urinary tract infection, bowel movement, hearing, vision, sleeping disorder, medication use, frailty and advanced care plans</i> using a validated tool within 24 hours of hospital admission.	8.5 (1.6) <sup>2</sup>	8 (1.8)
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Percentage of patients included in the geriatric co-management programme who had their care preferences documented in an advance care plan or advanced directive.	9 (1)	8 (1.8)
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Percentage of patients included in the geriatric co-management programme who have a discharge plan documented in their patient record.	9 (0.3)	8 (1)
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Percentage of patients included in the geriatric co-management programme who have a summary of their hospital care and post-discharge instructions send to their primary care practitioner and/or care facility.	9 (0)	8 (2)
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Abbreviations: Appr = Appropriateness; Feas = Feasibility; IQR = Interquartile Range;

1 Appropriateness and feasibility was determined by a disagreement index: see appendix for all indicators that were considered not appropriate or feasible; <sup>2</sup> scores have been averaged for all response options (see text in italic for the different response options): see appendix for the raw scores;

## Outcome indicators

Sixteen out of 24 outcome indicators were considered appropriate and feasible (see table 6). Five indicators were also appropriate but not feasible. The highest scoring outcome indicators were length of stay, time from admission to surgery, patient satisfaction with hospital care, institutionalisation and the incidence of delirium and wound infections.

Experts from Europe did consider that length of stay was appropriate, and monitoring physical restraints was feasible, but the level of agreement was insufficient to indicate consensus.

**Table 6. Outcome indicators for geriatric co-management programmes**

Indicators	Median Score (IQR)	
	<i>Appr</i>	<i>Feas</i>
<i>Indicators considered appropriate and feasible with agreement</i> <sup>1,2</sup>		
Mean length of stay in the hospital.	9 (1.3)	9 (1)
Mean time spent in the emergency department. <sup>3</sup>	7 (3)	8 (2)
Mean time from hospital admission to surgery. <sup>4</sup>	9 (1.5)	9 (1.3)
Readmission rate within 30 days and three months of hospital discharge.	8 (2) <sup>5</sup>	8 (2)
Patient satisfaction with hospital care.	9 (1)	7 (3)
Caregiver satisfaction with hospital care provided for patients included in the geriatric co-management programme.	8.5 (2)	7 (3)
Percentage of patients who were physically restrained during their hospital stay.	9 (2)	8 (3)

In-hospital mortality rate.	9 (2)	9 (0.3)
Percentage of patients admitted to a nursing home on hospital discharge.	9 (1)	9 (1)
Percentage of patients who declined in functional status between hospital admission and hospital discharge.	8 (2)	7 (3)
Percentage of patients who developed delirium.	9 (1)	8 (2)
Percentage of patients who developed a urinary tract infection.	9 (2)	9 (2)
Percentage of patients who developed a wound infection.	9 (1.3)	9 (1.3)
Percentage of patients who developed a pneumonia.	9 (2)	8 (2)
Percentage of patients who developed a sepsis.	9 (2.3)	9 (2)
Percentage of patients who developed a pressure ulcers.	9 (2)	8 (2)

Abbreviations: Appr = Appropriateness; Feas = Feasibility; IQR = Interquartile Range;

<sup>1</sup> Appropriateness and feasibility was determined by a disagreement index: see appendix for all scores; <sup>2</sup> The denominator relates to patients admitted in the co-management program; <sup>3</sup> the denominator only includes patients admitted through the emergency department; <sup>4</sup> the denominator only includes patient included in a surgical co-management program; <sup>5</sup> scores have been averaged for all response options (see text in *italic* for the different response options): see appendix for the raw scores

Supplementary Table S4 details the results for all indicators, including those considered not appropriate or feasible or indicators without consensus.

## DISCUSSION

This study aimed to find consensus on structure, process and outcome indicators that are appropriate and feasible to use for the implementation and evaluation of geriatric co-management programmes using a two-round Delphi study and systematic literature review. We included 33 participants from Europe and North America and observed consensus on 31 indicators that are considered both appropriate and feasible.

Experts indicated the importance of providing proactive care to frail patients by geriatric care professionals within 24 hours of hospital admission. A central focus of these programmes is the comprehensive geriatric assessment aiming to identify, prevent or manage geriatric syndromes and complications. There was a strong consensus that co-management should focus on areas related to delirium, functional status, falls, pressure ulcers, medication use, comorbidity, nutrition, pain, advance care planning and discharge planning and its communication.

The ability of comprehensive geriatric assessment to improve outcomes has been associated with the ability to implement the treatment plan by the multidisciplinary team.[3] There was a strong consensus that co-management programmes should be multidisciplinary and include a geriatrician, treating physician of the non-geriatric ward, a nurse with geriatrics expertise, physical therapist and social worker. There seems a value for daily co-management, yet experts argued that the frequency should be based on the severity of a specific patient case. Nonetheless, this reflects one of the hallmarks of co-management: shared decision making with daily communication.[62]

A standard set of outcome parameters for the evaluation of orthogeriatric co-management programmes was previously developed based on a review of orthogeriatric co-management

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3 evaluation studies,[63] and a consensus development conference.[64] Likewise to our  
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5 results, length of stay, time to surgery, incidence of complications, institutionalisation,  
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7 readmission rate and mortality were considered important outcomes. However, our Delphi  
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9 results disagreed with the panelist of the consensus development conference on post-  
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11 discharge follow-up of outcomes, which were generally not considered feasible by our  
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13 experts. Furthermore, the appropriateness of post-discharge follow-up declined the longer  
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15 the endpoint after hospitalization was defined. This indicates that in-hospital co-  
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17 management may not be expected to have long-term effects without appropriate follow-up  
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19 interventions after hospital discharge. Despite long-term follow-up being a key component  
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21 of comprehensive geriatric assessment,[4] this likely reflects a challenge of implementing  
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23 transitional care in routine practice as there are often no formal relationships between care  
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25 settings, no financial incentives, inadequate resources and communication, and a lack of  
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27 time.[65]

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33 Indeed, many effective interventions in healthcare fail to be implemented in practice.[8] Or  
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35 alternatively, many routine practices are not (as) effective as defined.[66] The results from  
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37 this Delphi study can be used to address this challenge. First, the indicators can be used to  
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39 measure the current performance of geriatric co-management programmes and identify  
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41 areas for improvement.[67] Second, the indicators can be used to start a new geriatric co-  
42  
43 management program. The structure and process indicators can be considered good  
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45 geriatric care for frail patients. However, their implementation should be tailored to the  
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47 local context of the health system, hospital and co-management programme. Third, the  
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49 indicators can be used to monitor both the effect and the implementation of the  
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51 programme.[68] We therefore advise to monitor both process and outcome indicators  
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3 when evaluating geriatric co-management programmes. This should be a continuous  
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5 process and should be followed by strategic improvement plans and re-evaluations.  
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### 7 **Methodological considerations**

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10 Some considerations should be noted. Firstly, the abstraction of data in the systematic  
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12 literature review was dependent of the quality of reporting in the primary studies. A recent  
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14 meta-analysis on geriatric co-management programmes observed a high risk of bias and  
15  
16 poor reporting of study methodology in published manuscripts.[5] This may result in  
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18 underreporting or missing information about particular structures and processes. For  
19  
20 example, detailed information about the implementation strategy or process data on the  
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22 actual delivery of interventions were missing. Secondly, the results are based largely on the  
23  
24 views of medical doctors as we could only recruit four nurses and one manager. The  
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26 selection of participants was based on those experts who responded to an e-mail invitation.  
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28 We did not specifically select medical doctors trained in geriatric medicine. For our  
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30 strategies, we used author lists from publications and abstracts and special interest groups  
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32 focusing on geriatric co-management. However, it is very likely that geriatricians are more  
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34 interested in geriatric co-management and therefore more likely to respond to an invitation.  
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36 The indicators may therefore not fully reflect the interdisciplinary nature of co-management  
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38 or the economics of implementing geriatrics care models (e.g. no economic indicators have  
39  
40 been defined). No patients were included because of the technical nature of the indicators  
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42 and the focus on system characteristics. Nonetheless, Patients' views on the acceptability of  
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44 implementing indicators should be considered. If not acceptable, the indicators will unlikely  
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46 result in improved outcomes. Thirdly, because the majority of evidence on geriatric co-  
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48 management originates from North America and Europe, the results of this study may only  
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50 be valid for these regions. Furthermore, it should be noted that despite the differences  
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3 between countries in organising their health systems, there were only minimal differences  
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5 in appropriateness between regions. Validation of the indicators in other countries is  
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7 recommended. Fourthly, the observed consensus is based on a specific sample of 33  
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9 motivated experts, and it is unclear if the same results would have been produced with a  
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11 different sample of experts. However, a systematic review concluded that RAND/UCLA  
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13 method has moderate to very good reliability and good construct and predictive validity.[69]  
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15 Fifthly, we did not define any threshold standards that should be met when evaluating the  
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17 indicators, and for many indicators these thresholds are not available. Finally, these  
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19 indicators are based on expert opinion in the absence of clinical trial data. The strength of  
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21 the evidence should therefore be considered very low and requires further testing for  
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23 validity and reliability.[14]  
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## 27 28 **Conclusion**

29  
30 This Delphi study identified 31 indicators for the evaluation of geriatrics co-management  
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32 programmes. Patient selection, early inclusion, and interdisciplinary care with geriatric  
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34 expertise based on a comprehensive geriatric assessment are considered key elements of  
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36 co-management programmes. The indicators can be used to assess the performance of co-  
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38 management programmes, identify areas for improvement and monitor the implementation  
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40 and effect of these programmes. Future research should focus on the development of post-  
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42 discharge outcomes who are feasible to measure, multicentre studies, cluster  
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44 randomization and process evaluation to support the scaling up of effective co-management  
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46 programmes.  
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## DECLARATIONS

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### Author contributions

All authors (BVG, LM, DAM, SMF, KF, KM, JF, MD) contributed to the study concept and design. BVG and LM contributed to the acquisition of subjects and/or data. BVG, KM, JF and MD contributed to the analysis and interpretation of data. All authors (BVG, LM, DAM, SMF, KF, KM, JF, MD) contributed to the preparation of the manuscript and critically revising it for important intellectual content. MD supervised this study.

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17

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20  
21  
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23  
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29  
30 conflict of interest.  
31  
32

### 33 34 **Availability of data and materials**

35  
36 No additional data are available  
37  
38

### 39 40 **ADDITIONAL FILES**

41  
42 **Additional file 1:** Supplementary Table S1. Study characteristics systematic literature  
43  
44 review.  
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47 **Additional file 2:** Supplementary Table S2. Indicators removed after round 1.  
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50 **Additional file 3:** Supplementary Table S3. Indicators added after round 1.  
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53 **Additional file 4:** Supplementary Table S4. Median scores and agreement index for all  
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55 indicators.  
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## FIGURES

### Figure 1. Outcomes reported by co-management programmes

Legend: The bar chart reports the number of programmes reporting a particular outcome.

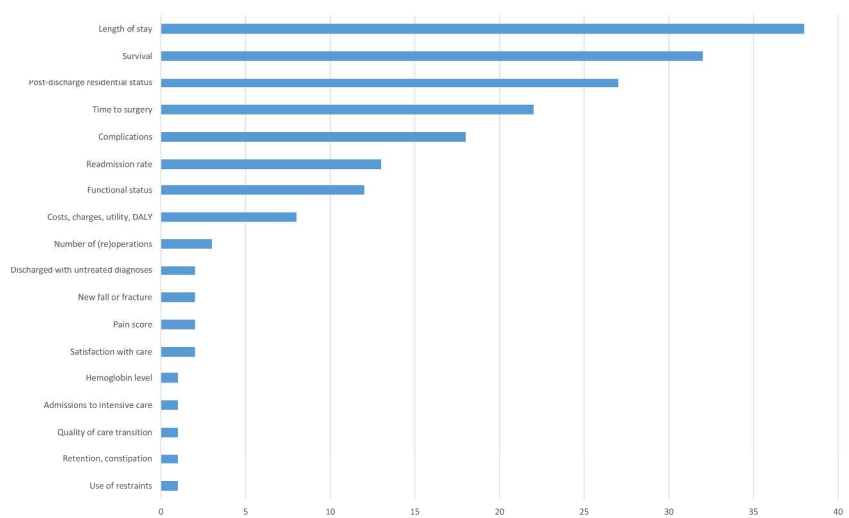
Abbreviations: DALY = Disability-Adjusted Life Year

### Figure 2. Flowchart of Delphi process

Legend: Consensus was determined based on the level of agreement using the RAND/UCLA appropriateness method. Indicators were rated on a scale of one to nine, and considered appropriate and feasible based on a medium score of seven or higher.

Note: Of the seventeen outcome indicators who were considered feasible, sixteen were also considered appropriate.

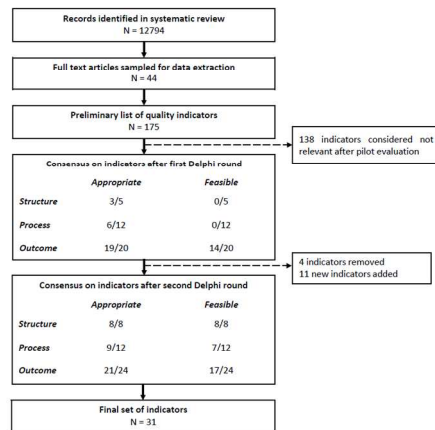
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Legend: The bar chart reports the number of programmes reporting a particular outcome.  
 Abbreviations: DALY = Disability-Adjusted Life Year

338x190mm (300 x 300 DPI)

Review only



25 Consensus was determined based on the level of agreement using the RAND/UCLA appropriateness method.  
 26 Indicators were rated on a scale of one to nine, and considered appropriate and feasible based on a medium  
 27 score of seven or higher.

28 Note: Of the seventeen outcome indicators who were considered feasible, sixteen were also considered  
 29 appropriate.

30 338x190mm (300 x 300 DPI)

**Supplementary Table S1. Study characteristics systematic literature review**

Study	Country	Design	Population
Adunsky 2003, 2011; Ginsberg 2013 [16 17 32]	Israel	Retrospective cohort study	Hip fracture patients aged 65 years or older
Antonelli Incalzi 1993 [19]	Italy	Before-and-after study with historic cohort	Patients aged 70 years or more admitted to the orthopaedic ward
Arbaje 2010 [20]	USA, Maryland	Non randomised controlled trial	Adults 70 years or older admitted on an internal medicine unit
Bhattacharyya 2013 [21]	UK	Retrospective before-and-after study	Hip fracture patients
Biber 2013 [22]	Germany	Before-and-after study with historic cohort	Hip fracture patients aged 60 years and older
Bielza Galindo 2013	Spain	Before-and-after study with historic cohort	Hip fracture patients aged 75 years or older



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3	[23]		cohort		
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6	Cogan 2010 [24]	Ireland	Retrospective	before-and-after	Hip fracture patients
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8			study		
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10					
11	Elliot 1996 [27]	New Zealand	Retrospective cohort study		Hip fracture patients aged 65 years or older
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13					
14	Farnworth 1994 [28]	Australia,	Retrospective	before-and-after	Hip fracture patients
15		New South	study		
16		Wales			
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21					
22	Fisher 2006 [45]	Australia, ,	Before-and-after study with historic		Patients aged 60 years or older with a primary diagnosis of
23		New South	cohort		nonpathological hip fracture
24		Wales			
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30	Folbert 2011, 2012	Netherlands	Before-and-after study with historic		Hip fracture patients aged 65 years or older
31					
32	[25 26]		cohort		
33					
34					
35					
36	Friedman 2009; Kates	USA, New	Retrospective cohort study		Patients aged 60 years or older admitted for surgical repair
37					
38	2011 [29 40]	York			of proximal femur fracture
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3	Germain 1995 [30]	Canada,	Randomised controlled trial	Functional or mental impaired elderly in-patients
4		Quebec		
5				
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7				
8				
9	Gilchrist 1988 [31]	UK	Randomised controlled trial	Women with hip fracture aged 65 years or older
10				
11				
12	Gregersen 2012 [35]	Denmark	Retrospective	before-and-after study Hip fracture patients aged 65 years or older
13			study	
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17	Grund 2015 [36]	Germany	Before-and-after study with historic	Patients with a fracture aged 75 years or older cohort
18			cohort	
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23	Gupta 2014 [37]	UK	Before-and-after study with historic	Hip fracture patients aged 50 years or older cohort
24			cohort	
25				
26				
27				
28	Harari 2007 [39]	UK	Prospective before-and-after study	High-risk medical inpatients aged 70 years or older
29				
30				
31	Harari 2007 [38]	UK	Prospective before-and-after study	Elective orthopaedic patients aged 65 years or older
32				
33				
34	Leung 2011 [44]	China	Retrospective	before-and-after study Hip fracture patients aged 60 years or older
35			study	
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4	Khan 2002 [41]	UK	Prospective before-and-after study	Elderly patients admitted for fractured femur neck
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6	Khasraghi 2005 [42]	USA,	Retrospective	before-and-after
7		Baltimore	study	Elderly hip fracture patients
8				
9		(Maryland)		
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14	Kristensen 2015 [43]	Denmark	Retrospective cohort study	Hip fracture patients aged 65 years or older
15				
16				
17	Marsland 2010 [46]	UK	Prospective before-and-after study	Hip fracture patients
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19				
20	Mazzola 2010 [47]	Italy	Prospective cohort study	Hip fracture patients aged 70 years and older
21				
22				
23	Miura 2009 [48]	USA, Oregon	Before-and-after study with historic	Hip fracture patients aged 55 years or older
24			cohort	
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27				
28	Gonzalez-Montalvo	Spain	Prospective cohort study	Patients with osteoporotic hip fracture aged 65 years or
29				
30	2010, 2011 [33 34]			older
31				
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33				
34	Naglie 2002 [49]	Canada,	RCT	Hip fracture patients aged 70 years or older
35				
36		Toronto		
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Ortiz 2008 [18]	Spain	Before-and-after study with historic cohort	Hip fracture patients aged 65 years or older
Sennour 2009 [50]	USA, Indiana	Retrospective cohort study	Older patients at risk for functional decline
Slaets 1997 [51]	Netherlands	RCT	Medical inpatients aged 75 years or older
Street 1994 [52]	Australia	Before-and-after study with historic cohort	Hip fracture patients aged 50 or older
Suhm 2014 [53]	Switzerland	Prospective before-and-after study	Hip fracture patients aged 65 years or older
Swanson 1998 [54]	Australia, Queensland	Randomised controlled trial	Hip fracture patients aged 55 years or older
Tha 2009 [55]	Australia	Retrospective cohort study	Hip fracture patients aged 65 years or older
Vidan 2005 [56]	Spain	Randomised controlled trial	Patients aged 65 years or older admitted for acute hip fracture surgery
Wagner 2012 [57]	Chile	Before-and-after study with historic cohort	Hip fracture patients aged 65 years or older

1  
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3 cohort

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6 Zeltzer 2014 [58] Australia, Multicentre Retrospective Hip fracture patients aged 65 or older

7  
8 New South cohort study

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10 Wales

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13  
14 Zuckerman 1991 [59] USA, New Retrospective before-and-after Hip fracture patients aged 65 years or older

15  
16 York study

**Supplementary table S2: Indicators removed after round 1****Indicators removed after round 1****Reason**

- |   |  |
|---|--|
| 1. Percentage of hospital staff participating in the geriatric co-management programme who received education by a member of the geriatric team on the identification and management of geriatric syndromes | Participants suggested to replace this with a new indicator                      |
| 2. For surgical patients, co-management starts preoperatively   | Participants suggested to replace this with a new indicator                      |
| 3. For medical patients, co-management starts within 24 hours of hospital admission   | Participants suggested to replace this with a new indicator                      |
| 4. The geriatrician and treating physician meet to discuss patients included in the geriatric co-management programme.  | Participants noted that it contains duplicate information with another indicator |

**Supplementary table S3: Indicators added after round 1****New indicators added after round 1****Reason**

1. A member of the geriatric team is available on a daily basis for patients included in the geriatric co-management programme. Suggestion by participant
2. Team meetings for reviewing the performance on indicators associated with the geriatric co-management programme are organised at least once yearly with the aim of evaluating the current performance and formulating strategic improvement plans. Suggestion by participant
3. An educational program or sessions are organized or facilitated at induction of every new staff member, and at least once a year for all current hospital staff participating in a geriatric co-management programme, focusing on the identification and management of geriatric syndromes. Suggestion by participant
4. Percentage of patients eligible for geriatric co-management who were assessed or screened for their eligibility to be included in the geriatric co-management program. Suggestion by participant
5. Percentage of patients included in the geriatric co-management programme who received post-discharge follow-up from a member of the geriatric team. Suggestion by participant

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2  
3 6. If a co-managed patient is discharged to a facility, a member of the geriatric co-management team Suggestion by participant  
4  
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6 calls the facility with post-discharge instructions.  
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9 7. Satisfaction with the co-management service, rated by the treating physician of the ward Suggestion by participant  
10

11 participating in the geriatric co-management programme.  
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13

14 8. Satisfaction with the co-management service, rated by the nursing staff of the ward participating in Suggestion by participant  
15  
16

17 the geriatric co-management programme.  
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19  
20 9. Perceived level of support by hospital staff participating in the geriatric co-management Suggestion by participant  
21

22 programme in caring for geriatric patients rated on a numeric scale (0 to 10).  
23  
24

25 10. Evidence-based protocols for the prevention and/or management of *sleep deprivation, functional* Suggestion by participant  
26

27 *impairment, frailty* are available to hospital staff participating in the geriatric co-management  
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29 programme. (three new response options were added)  
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33 11. Percentage of patients included in the geriatric co-management programme who had a screening Suggestion by participant  
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35 or assessment focusing on depression, dysphagia, frailty using a validated tool within 24 hours of  
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37 hospital admission.  
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Supplementary Table S4. Median scores and agreement index for all indicators

Indicator	Median (IQR)		Agreement Index <sup>a</sup>	
	Appropriateness	Feasibility	Appropriateness	Feasibility
<b>Structure indicators</b>				
A(n) ... (see response options below) is a core member of the geriatric co-management programme.		8 (2)		-0.6
<i>Geriatrician</i>	9 (0)		0	
<i>Treating physician of the ward</i>	8 (1.3)		-0.3	
<i>Physician assistant</i>	4.2 (3.3)		1.9	
<i>Geriatric nurse practitioner</i>	6.2 (3)		-1.8	
<i>Registered Nurse with geriatric expertise</i>	7 (2)		-0.9	
<i>Registered nurse OR nurse practitioner with geriatric expertise</i>	8 (1)		-0.4	
<i>Nursing staff of the ward</i>	7 (2)		-0.9	
<i>Physical therapist</i>	8 (1)		-0.3	

Occupational therapist	7 (2)		-0.9	
Social worker or discharge of case manager	8 (1)		-0.3	
Dietician	6,5 (2)		10	
Speech therapist	6.5 (3.3)		30	
Pharmacist	7 (2)		-3.1	
A member of the geriatric team is available on a daily basis for patients included in the geriatric co-management programme.	8 (1)	8 (2)	-0.3	-0.3
Team meetings for reviewing the performance on indicators associated with the geriatric co-management programme are organized at least once yearly with the aim of evaluating the current performance and formulating strategic improvement plans.	8 (1)	8 (1)	-0.3	-0.3
An educational programme or sessions are organised or facilitated at induction of every new staff member, and at least once a year for all	8 (2)	8 (2)	-0.3	-0.3

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2  
3 current hospital staff participating in a geriatric co-management  
4  
5 programme, focusing on the identification and management of geriatric  
6  
7 syndromes.  
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10  
11 A validated screening tool or objective criteria to select patients for the  
12  
13 geriatric co-management programme is available to all hospital staff.  
14

15  
16 A multidisciplinary care pathway is available detailing the roles and  
17  
18 responsibilities of all hospital staff participating in the geriatric co-  
19  
20 management programme.  
21  
22

23  
24 Evidence-based protocols for the prevention and/or management of ...  
25  
26 (*see response options below*) are available to hospital staff participating in  
27  
28 the geriatric co-management programme.  
29  
30

31  
32 *Cognitive impairment* 9 (1) 8 (1) -0.3 -0.1  
33

34  
35 *Delirium* 9 (0) 0  
36

37  
38 *Depression* 7 (2.3) -0.9  
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<i>Hospital-acquired infections</i>	8 (2)	-0.3
<i>Pressure ulcers</i>	9 (1)	-0.3
<i>Incontinence</i>	8 (2)	-0.9
<i>Urinary retention</i>	8 (2)	-0.8
<i>Constipation</i>	8.5 (1)	-0.3
<i>Pain</i>	9 (1)	-0.3
<i>Palliative care</i>	8 (2)	-0.8
<i>Polypharmacy</i>	9 (2)	-0.3
<i>Malnutrition</i>	8 (2)	-0.9
<i>Falls</i>	9 (1)	0
<i>Osteoporosis</i>	8 (2)	-0.9
<i>Sleep deprivation</i>	7 (1.8)	-0.9

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3					
4	<i>Functional impairment/mobility</i>	9 (1)		-0.3	
5					
6	<i>Frailty</i>	8 (2.8)		-0.9	
7					
8					
9	Standard geriatric order sets (e.g. labs, technical investigations) are	9 (3)	8 (1)	-0.9	-0.3
10	available to hospital staff participating in the geriatric co-management				
11	programme.				
12					
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14					
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16					
17	<b>Process indicators</b>		<b>Appropriateness</b>	<b>Feasibility</b>	<b>Appropriateness</b>
18					<b>Feasibility</b>
19					
20	For patients included in the geriatric co-management programme, co-	9 (1)	8 (2)	-0.3	-0.3
21	management starts preoperatively or within 24 hours of hospital				
22	admission.				
23					
24					
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26					
27					
28	Mean time spent in the emergency department, of patients included in	8 (1)	8 (1)	-0.3	-0.3
29	the geriatric co-management programme.				
30					
31					
32					
33	A member of the geriatric team meets daily with the nurses on the wards	9 (1)	7 (2)	0	-3.1
34	participating in the geriatric co-management programme.				
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Collaborative interdisciplinary meetings with the primary treating hospital staff participating in the geriatric co-management programme and a member of the geriatric team are organised to discuss patients included in the geriatric co-management programme at least twice a week.	7 (1)	8 (2)	-0.7	-0.8
--	-------	-------	------	------

A member of the geriatric team communicates the findings of the geriatric assessment, recommendations and care plans of patients included in the geriatric co-management programme verbally with the primary treating hospital staff.	9 (1)	7 (4.8)	-0.3	-7.4
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Percentage of patients eligible for geriatric co-management who were assessed or screened for their eligibility to be included in the geriatric co-management programme.	7 (2)	7 (3)	-3.1	-3.1
--	-------	-------	------	------

Percentage of patients included in the geriatric co-management programme who had a screening or assessment focusing on ... (see response options below) using a validated tool within 24 hours of hospital	8 (1.8)			-0.9
--	---------	--	--	------

admission.		
<i>Delirium</i>	9 (1)	-0.3
<i>Dementia</i>	8.5 (2)	-0.3
<i>Depression</i>	6 (3)	-3.1
<i>Functional status</i>	9 (0)	0
<i>Fall risk</i>	9 (1.3)	-0.3
<i>Social aspects and environment</i>	9 (2)	-0.8
<i>Comorbidity</i>	9 (2)	-0.3
<i>Pressure ulcer risk</i>	8.5 (2)	-0.3
<i>Pain</i>	9 (1)	0
<i>Nutritional status</i>	9 (1.3)	-0.3
<i>Incontinence</i>	8 (2)	-0.3

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4	<i>Urinary retention</i>	8 (2)			-0.9
5					
6	<i>Bowel movement</i>	8 (1.3)			-0.3
7					
8					
9	<i>Hearing</i>	8 (2)			-0.9
10					
11					
12	<i>Vision</i>	8 (2)			-0.9
13					
14					
15	<i>Sleeping disorder</i>	7 (2.5)			-0.9
16					
17					
18	<i>Medication use</i>	9 (1)			0
19					
20					
21	<i>Dysphagia</i>	7 (3.8)			-2.1
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23					
24	<i>Frailty</i>	8 (1.8)			-0.7
25					
26					
27	<i>(health related) quality of life</i>	6 (4)			30
28					
29					
30	<i>Advanced directive/care plan</i>	8,5 (1)			-0.3
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32					
33	Percentage of patients included in the geriatric co-management	9 (1)	8 (1.8)	-0.3	-0.3
34	programme who had their care preferences documented in an advance				
35	care plan or advanced directive.				
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Percentage of patients included in the geriatric co-management programme who have a discharge plan documented in their patient record.	9 (0.3)	8 (1)	0	-0.3
Percentage of patients included in the geriatric co-management programme who have a summary of their hospital care and post-discharge instructions send to their primary care practitioner and/or care facility.	9 (0)	8 (2)	0	-0.8
Percentage of patients included in the geriatric co-management programme who received post-discharge follow-up from a member of the geriatric team ... <i>(see response options below)</i> .	7 (1)	7 (1)	-2.6	-2.6
<i>Within 3 days of hospital discharge</i>	6.5 (6)		-46.1	
<i>Within 5 days of hospital discharge</i>	6.5 (5)		5.4	
<i>Within 7 days of hospital discharge</i>	7 (3.8)		-9.7	

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<i>Within 14 days of hospital discharge</i>	7 (3)		-26.6	
If a co-managed patient is discharged to a facility, a member of the geriatric co-management team calls the facility with post-discharge instructions.	7 (3)	6 (3.8)	-4.8	2.1
<b>Outcome indicators</b>		<b>Appropriateness</b>	<b>Feasibility</b>	<b>Appropriateness</b> <b>Feasibility</b>
Mean length of stay in the hospital, of patients included in the geriatric co-management programme.	9 (1.3)	9 (1)	-0.3	-0.3
Daily patient rounds are performed by a member of the geriatric team participating in the geriatric co-management programme.	7 (3)	8 (2)	-0.9	-0.3
Mean time from hospital admission to surgery, of surgical patients included in the geriatric co-management programme.	9 (1.5)	9 (1.3)	-0.3	-0.3
Readmission rate of patients included in the geriatric co-management programme within ... <i>(see response options below)</i> .		8 (2)		-0.9

1 2 3 4 5	<i>Within 30 days of hospital discharge</i>	9 (1)		-0.3	
6 7 8	<i>Within 3 months of hospital discharge</i>	7 (3)		-0.9	
9 10 11	<i>Within 6 months of hospital discharge</i>	5 (3)		1.9	
12 13 14	<i>Within 1 year of hospital discharge</i>	5 (6.5)		3.3	
15 16 17 18 19	Patient satisfaction with hospital care, of patients included in the geriatric co-management programme.	9 (1)	7 (3)	-0.3	-0.9
20 21 22 23 24 25	Caregiver satisfaction with hospital care provided for patients included in the geriatric co-management programme.	8.5 (2)	7 (3)	-0.3	-0.9
26 27 28 29 30	Percentage of patients included in the geriatric co-management programme who were physically restrained during their hospital stay.	9 (2)	8 (3)	-0.9	-0.9
31 32 33 34 35 36	In-hospital mortality rate of patients included in the geriatric co-management programme.	8 (2)	9 (0.3)	-0.3	0
37 38 39 40 41 42	Post-discharge mortality rate of patients included in the geriatric co-		7 (3)		30

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management programme ... (see response options below).				
Within 30 days of hospital discharge	8,5 (2)		-0.3	
Within 3 months of hospital discharge	7 (3.5)		-1.3	
Within 6 months of hospital discharge	5,5 (3)		-22.6	
Within 1 year of hospital discharge	7 (5)		-6.2	
Percentage of patients included in the geriatric co-management programme admitted to a nursing home on hospital discharge.	9 (1)	9 (1)	-0.3	-0.3
Percentage of patients included in the geriatric co-management programme admitted to a nursing home <i>post-discharge</i> ... (see response options below).		6 (4.5)		32
Within 30 days of hospital discharge	8 (3)		-0.9	
Within 3 months of hospital discharge	5.5 (2.3)		14.5	
Within 6 months of hospital discharge	5 (3)		0.9	

<i>Within 1 year of hospital discharge</i>	4 (4.5)		1.6	
Percentage of patients included in the geriatric co-management programme who declined in functional status between hospital admission and hospital discharge.	8 (2)	7 (3)	-0.8	-0.7
Percentage of patients included in the geriatric co-management programme who declined in cognitive functioning between hospital admission and post-discharge ... (see response options below).		5 (3.5)		1.9
<i>Within 30 days of hospital discharge</i>	8 (2)		-0.3	
<i>Within 3 months of hospital discharge</i>	7 (3)		30	
<i>Within 6 months of hospital discharge</i>	5 (3)		2.3	
<i>Within 1 year of hospital discharge</i>	5 (4.5)		1.7	
Percentage of patients included in the geriatric co-management programme who declined in cognitive functioning between hospital	8 (3)	6.5 (2.5)	-0.9	14.5

admission and hospital discharge.

Percentage of patients included in the geriatric co-management programme who declined in cognitive functioning between hospital admission and post-discharge ... (see response options below).		5 (3)		0.9	
<i>Within 30 days of hospital discharge</i>		7 (3)		-1.0	
<i>Within 3 months of hospital discharge</i>		6 (2.3)		2.4	
<i>Within 6 months of hospital discharge</i>		5 (4)		1.7	
<i>Within 1 year of hospital discharge</i>		5 (4)		1.0	
Percentage of patients included in the geriatric co-management programme who developed/experienced delirium.		9 (1)	8 (2)	-0.3	-0.8
Percentage of patients included in the geriatric co-management programme who developed/experienced an urinary tract infection.		9 (2)	9 (2)	-0.8	-0.8
Percentage of patients included in the geriatric co-management programme who developed/experienced an urinary tract infection.		9 (1.3)	9 (1.3)	-0.3	-0.3

programme who developed/experienced a wound infection.

Percentage of patients included in the geriatric co-management programme who developed/experienced a wound infection	9 (2)	8 (2)	-0.3	-0.9
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programme who developed/experienced a pneumonia

Percentage of patients included in the geriatric co-management programme who developed/experienced a pneumonia	9 (2.3)	9 (2)	-0.3	-0.3
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programme who developed/experienced a sepsis

Percentage of patients included in the geriatric co-management programme who developed/experienced a sepsis	9 (2)	8 (2)	-0.3	-0.9
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programme who developed/experienced a pressure ulcers

Satisfaction with the co-management service, rated by the treating physician of the ward participating in the geriatric co-management programme.	7 (3)	7 (3)	-3.1	-3.1
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physician of the ward participating in the geriatric co-management programme.

Satisfaction with the co-management service, rated by the nursing staff of the ward participating in the geriatric co-management programme.	7.5 (2)	7 (3)	-0.8	-3.1
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the ward participating in the geriatric co-management programme.

Perceived level of support by hospital staff participating in the geriatric co-management programme in caring for geriatric patients rated on a	6 (3.5)	6.5 (4.8)	-3.1	8.1
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co-management programme in caring for geriatric patients rated on a

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numeric scale (0 to 10).

Abbreviations: IQR = interquartile range;

<sup>a</sup> An agreement index score of < 1 indicates consensus between experts. Note: the higher the interquartile range, the higher the agreement index score, and the lower the level of consensus.

For peer review only