Comprehensive geriatric assessment (CGA) in perioperative care: a systematic review of a complex intervention

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ABSTRACT

Objectives Comprehensive geriatric assessment (CGA) is a complex intervention applied to older people with evidence of benefit in medical populations. The aim of this systematic review was to describe how CGA is applied to surgical populations in randomised controlled trials. This will provide a basis for design of future studies focused on optimising CGA as a complex intervention.

Setting A systematic review of randomised controlled trials.

Participants A systematic search was performed for studies of CGA in the perioperative period across Ovid MEDLINE, Ovid EMBASE, CINAHL and Cochrane CENTRAL, from inception to March 2021.

Interventions Any randomised controlled trials of perioperative CGA versus ‘standard care’ were included.

Outcome measures Qualitative description of CGA.

Results 12 121 titles and abstracts were screened, 68 full-text articles were assessed for eligibility and 22 articles included, reporting on 13 trials. 10 trials focused on inpatients with hip fracture, with 7 of these delivering CGA on a geriatric medicine ward, 3 on a surgical ward. The remaining three trials were in elective general surgery, all delivering CGA on a surgical ward. CGA components, duration of intervention and personnel delivering the intervention were highly variable across the different studies. Trials favoured postoperative delivery of CGA (11/13). Only four trials reported data on adherence to the CGA intervention.

Conclusions CGA as an intervention is variably described and delivered in randomised controlled trials in the perioperative setting. The reporting of both the intervention and standard care is often poor with little focus on adherence. Future research should focus on clearly defining and standardising the intervention as well as measuring adherence within trials.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Comprehensive search strategy identifying more randomised controlled trials in surgery than have been identified in previously published systematic reviews.

⇒ Results reported according to the Template for Intervention Description and Replication checklist.

⇒ Two reviewers screened and collected data independently, with a third reviewer resolving any conflicts.

⇒ Quantitative outcomes are reported but not analysed as the focus of the review is qualitative.

INTRODUCTION

One-third of people having surgery are at least 75 years old and this proportion is increasing.1 Older people having surgery are more likely to experience postoperative complications compared with younger people. This includes longer hospital stays, increased risk of being discharged with additional care and incurring higher health and social care costs.2-4 Factors that contribute to these worse outcomes include age, multimorbidity and associated polypharmacy, cognitive and functional impairment, and living with frailty. For example the National Emergency Laparotomy Audit (NELA), report a doubling of 30-day mortality in patients aged over 65 years living with frailty (9.3% vs 18%).2,3

In order to modify outcomes, comprehensive geriatric assessment (CGA) is a complex intervention that has been implemented for older people having surgery. It can be traced back to the 1930s with Marjory Warren being one of the first advocates for developing dedicated services for older people.5-7 Its aim is to provide a thorough evaluation and optimisation of older patients to improve outcomes. The complexity of CGA is demonstrated in a currently accepted definition: ‘a multidimensional diagnostic and therapeutic process that is focused on determining a frail older person’s medical, functional, mental, and social capabilities and limitations with the goal of ensuring that problems are identified, quantified and managed appropriately.’6 CGA has been demonstrated to have efficacy in medical, surgical and outpatient settings with reductions in mortality and discharge to a dependency care home up to a year of follow-up.4,6,8
CGA has been evaluated within trials in a perioperative setting. However, the most recent 2018 Cochrane review found that most studies are either retrospective, or if randomised, mostly limited to patients with hip fracture. It concluded there is some evidence that CGA improves outcomes in hip fracture but not enough evidence for other surgical conditions. There was no analysis of the intervention description across trials. To date, there has been no analysis of the description of CGA as applied to patients receiving surgical care. Gaining an understanding of what is truly delivered as a ‘CGA’ in trial settings will allow new insights into how it may be optimised for the perioperative setting.

The aim of this review is to describe CGA as an intervention as it is delivered to surgical populations in randomised controlled trials (RCTs). This will provide an understanding of the current literature and potentially facilitate the design of future studies assessing CGA as a complex intervention in perioperative care and enhance translation of the intervention to clinical practice.

**METHODS**

This systematic review of intervention methodology has been reported in line with Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (online supplemental table 1). A protocol has previously been published by BMJ open. It is registered with PROSPERO CRD42020221797.

**Eligibility criteria**

Studies included were RCTs of CGA applied to patients having surgery compared with a ‘standard-of-care’ control group. There was no age cut-off, and no limitation by outcomes.

For the purpose of inclusion, if not otherwise identified as CGA by the study, we have defined CGA as: any review of a patient by a healthcare professional with training in geriatric medicine (eg, consultant, trainee and specialist nurse). We excluded any review by a healthcare professional that was not reported to have received training in geriatric medicine (eg, general practitioner or specialist nurse). We excluded any review by a healthcare professional without any report of geriatric training.

The perioperative period was defined as any time between the ‘decision to offer surgery, through to the weeks and months after the procedure.’ Any CGA review reported outside of this period was excluded.

**Information sources and search strategy**

A search strategy was developed with the help of an information specialist including the themes ‘geriatric care,’ ‘frailty,’ ‘surgery or trauma’ and ‘randomised controlled trials.’ This was run across EMBASE, Medline, CINAHL and Cochrane library from inception to 16 March 2021. Full search details can be found in online supplemental file - appendix 1. References of relevant studies were handsearched for any other relevant studies.

**Study selection and data extraction**

Study screening was performed using Covidence. Titles and abstracts were independently screened by two reviewers (RLM and JDB). Full texts were then independently screened by the same two reviewers.

All data were extracted in whole by two independent reviewers (RLM and JDB) using a predefined template. Data items are listed in the protocol.

Discrepancies or disagreements at all stages were resolved by discussion between the two main reviewers (RLM and JDB). If there was still no consensus a third reviewer made the final decision (PB).

**Risk of bias**

Risk of bias at the study level was assessed using the Cochrane risk of bias tool, version 2. Two independent reviewers rated each study. Results were compared and discrepancies were resolved by discussion.

**Data synthesis and analysis**

A narrative synthesis is presented for all qualitative outcomes. Content analysis has been undertaken to detail the intervention, assessments and outcomes presented in tabulated form, summarising each study side by side as adapted from similar studies. Reporting of the intervention descriptions uses the relevant aspects (items 2–12) of the Template for Intervention Description and Replication checklist as a framework.

No meta-analysis was undertaken as the primary aim of this review was a detailed description and analysis of the CGA intervention within each of the trial settings rather than outcomes. A tabular summary of reported statistics in each trial is presented.

**RESULTS**

**Study selection and characteristics**

The search strategy identified 12121 studies. After title and abstract screening, 68 full-text articles were assessed for eligibility and 22 included (figure 1). Nine articles reported alternative results from an already included trial, resulting in 13 trials included in the final analysis. No further articles were identified from handsearching references.

Thirteen trials included a total of 3118 patients, 1610 randomised to CGA and 1508 randomised to ‘standard care.’ The most common minimum age of inclusion was 65 years (n=6), followed by 70 years (n=3). One trial had no minimum age of inclusion (online supplemental table 2). Two trials used a frailty score (Groningen Frailty Indicator, Vulnerable Elders Survey 13) as part of their inclusion criteria.

Ten trials examined patients in the emergency setting with hip fracture (online supplemental table 2). Three trials included people undergoing elective surgery: resection of adenocarcinoma of the colon and/or rectum (n=1), endovascular or open aortic aneurysm repair or...
lower-limb arterial bypass surgery (n=1) and surgery for a solid tumour (n=1).

**Description of intervention**

**Why**

Five trials reported some rationale or theory behind the use of CGA, or the authors’ version of CGA, in the perioperative setting.

**What**

The components of CGA varied across trials (table 1). The most included components within the CGA were activities of daily living (n=11), cognitive function (n=10), nutritional status (n=9) and medication review (n=9). Reviewing the assessment tools used within the intervention (eg, Barthel Index to assess activities of daily living), there was no consistency identified across all studies and domains (online supplemental table 3). Aspects such as multidisciplinary team meetings and early discharge planning were not consistently described (table 1). There were two trials that reported preoperative assessment. Following preoperative assessment, Partridge et al reported the number of patients withdrawn from surgery (n=14) was more than double that in the control group (n=6). Ommundsen et al did not report on withdrawals from surgery following preoperative assessment in either arm.

**Who (team members)**

Compared with the control group, healthcare professionals unique to, more specialist, or more available in the intervention group were: a geriatric nurse specialist (n=7), an occupational therapist (n=7), a social worker (n=5) or a physiotherapist (n=5). Other team members such as a dietician, rehab specialist or psychiatrist were included infrequently in the CGA teams described (table 1). Two trials reported the number of healthcare professionals involved in delivering the CGA (eg, ‘three nurses, a social worker, two occupational therapists and a physiotherapist’) with all others only providing details of the mix of healthcare professionals who reviewed patients without a clear definition of overall numbers (eg, ‘a geriatrician, nurse, physiotherapist and occupational therapist were expected to assess patients’).

**How**

CGA was delivered individually in a face-to-face consultation in all trials.
### Table 1  Descriptors of CGA intervention and comparison with what is described in control groups

| Emergency hip fracture | Elective surgery |
|------------------------|------------------|
| **Team members**       |                  |
| Specialist geriatrician (consultant/trainee/not defined) | | |
| Surgeon                |                  |
| Ward staff             |                  |
| Nurse specialist (geriatric) | | |
| Occupational therapist |                  |
| Physiotherapist        |                  |
| Social worker          |                  |
| Dietician              |                  |
| Rehabilitation specialist |              |
| Nurse specialist (non-geriatric) | | |
| Orthotics              |                  |
| General internal medicine resident | | |
| General practitioner (standard) | | |
| Psychiatrist           |                  |
| General practitioner (geriatric trained) | | |
| Neuropsychologist       |                  |
| Neurologist            |                  |
| Staff not specified    |                  |

| CGA components assessed and managed (see online supplemental tables 3, 4) for details |
|--------------------------------------------------------------------------------------------|
| Activities of daily living |                  |
| Cognitive function         |                  |
| Nutritional status         |                  |
| Medication                 |                  |
| Mobility                   |                  |
| Social support             |                  |
| Anaemia                    |                  |
| Hydration                  |                  |
| Mental health              |                  |
| Comorbidity                |                  |
| Pain                       |                  |
| Bowels/bladder             |                  |
| Cardiac                    |                  |
| Infection                  |                  |

Continued
### Table 1  Continued

| Emergency hip fracture | Elective surgery |
|------------------------|------------------|
|                        |                  |
|                        |                  |

| Sleep |                  |
|-------|------------------|
|       | I                |

| Falls |                  |
|-------|------------------|
|       | I                |

| Sensory impairment |                  |
|--------------------|------------------|
|                    | I                |

| Oxygenation |                  |
|-------------|------------------|
|             | I                |

| Thrombosis |                  |
|------------|------------------|
|            | I                |

| Pressure sores |                  |
|----------------|------------------|
|                | I                |

### CGA components *generic*

| Multidisciplinary team meeting |                  |
|------------------------------|------------------|
|                              |                  |
|                              |                  |

| Care plan shared with surgical team |                  |
|-------------------------------------|------------------|
|                                     | I                |

| Prioritisation of care plan components |                  |
|                                      | I                |

### Point of CGA delivery

#### Assessment

| Preoperative | Outpatient | I |
|--------------|------------|---|
| Inpatient    | *          | * |
| Postoperative| Inpatient  | * |
|              | I          | I |

#### Care plan

| Preoperative | Outpatient | I |
|--------------|------------|---|
| Inpatient    | *          | * |
| Postoperative| Inpatient  | * |
|              | I          | I |

### Contact with geriatric team

| Single assessment |                  |
|-------------------|------------------|
| Multiple reviews by geriatric team |                  |
| Postoperative care on geriatric ward |                  |
| Postoperative care on surgical ward |                  |

If patients in the 'comparator arm' of the study received geriatric input on request, the detail of this was never described and therefore has not been populated into the CGA components, while explicit information on control group assessment/management has been.

- Only the intervention group received.
- Both intervention and control received, but intervention group received an 'enhanced version', for example, more often, specialist staff, regularly rather than on request).
- Intervention and control groups received the same.
- Control group received more often than intervention group.
- Only control group.
- Not reported as occurring in this trial.

*Not all patients received this aspect of the intervention.

CGA, comprehensive geriatric assessment.
Where
Trials focussing on hip fracture trials favoured the delivery of CGA on a geriatric ward (7/10, table 1). The remaining three hip fracture trials (3/10) and all the elective surgery trials delivered care on a surgical ward (3/3).

When and how much
The timing of CGA delivery was determined by the mode of admission—elective trials all delivered CGA preoperatively (3/3). The emergency trials delivered CGA almost exclusively postoperatively (10/10) although some of these trials reported that patients occasionally received a preoperative assessment if time allowed (4/10, table 1). Two trials reported the delivery of a single review by a geriatric team, with all other trials reporting multiple reviews. (table 1).

Tailoring
All studies reported some element of tailoring the intervention, mostly (n=12) that the management plan was based on assessments made (table 1). Marcantonio et al detailed prioritisation of up to five recommendations to improve adherence.32

Modifications
No trials reported modification of the intervention during the study.

How well (adherence)
Adherence to the intervention was reported in five trials (online supplemental table 1).29,30,32,34,35 Only Ommundsen et al reported the number of people randomised who received no intervention.34 One trial reported that adherence was checked, but did not report any related data.30

The way in which adherence was reported in each trial varied and data could not be combined to give an overall estimate.

Control group description
The control group description varied from single sentence description for example, ‘local hospital care’ to more in-depth description and side by side comparison with the intervention group.18 Of note, a specialist geriatrician review was available in the control group on request in 8 of 13 trials. Only Naglie et al reported how often this occurred (8%).33 Assessments were sometimes reported in the control group e.g. social support and mobility but this was inconsistently reported (table 1). Only five trials commented on the number of allied health professionals available in the control group compared with the intervention group (eg, ‘less physiotherapists’). (online supplemental table 1)

Outcomes
The primary outcomes of all trials are reported in table 2. All primary outcomes reported fit within the COMPAC-StEP core outcome set.36 Comparing components assessed to primary outcomes, the studies that reported a primary outcome focused on cognition tended to assess more of the delirium prevention strategy as defined by NICE. This reflects recognition of biological plausibility in affecting outcomes.

Risk of bias across studies
Only two studies reported were at low risk of bias, which were the most recent studies. Six studies had some concern and five were at high risk of bias (online supplemental tables 1; 5).

Ongoing studies
During the search, two published protocols with no reported results were identified. One was terminated due to insufficient patient recruitment, and the other protocol was only published in 2021.40,41

DISCUSSION
This review identified 13 RCTs comparing CGA with standard care in a surgical population. The majority of these were in patients with hip fracture, and only three covering orthopaedic surgical specialties. There was no clear consensus across all trials on what, where, when, how much or by whom, CGA should be delivered, similar to what has been reported in medical CGA trials.42 Some components that were included in CGA could reasonably be expected to be provided as standard care (eg, haemoglobin check) and possibly represent some redundancy within CGA. There was also no consistent reporting on intervention adherence, making it unclear how many patients overall were receiving the designated intervention. Precise numbers of healthcare professionals were also not often reported in the intervention and only five trials reported the difference in allied health professionals between intervention and control groups. This is critical information needed to understand the resource implication of CGA in a perioperative setting. Taken together, it is difficult to conclude what ‘optimum’ CGA in a perioperative setting should look like and how much this should differ from standard care.

A recent review attempted to outline the core components of CGA in medical patients, however, this is the first study to evaluate the features of CGA in a perioperative setting.42 A search for ‘perioperative CGA’ on Web of Science shows that the number of articles written has been gradually increasing year on year, demonstrating an increased interest among researchers on the topic.43 However, clinical practice may not be keeping up. The most up to date NELA report from 2018 to 2019 stated a fall in percentage of patients over 65 years receiving geriatric input (28.8%) compared with 2017–2018 (36.9%).44,45 There may be a number of reasons for this both from a service delivery and trials view. As we have shown CGA is a complex intervention requiring intensive resources and organisation to implement, hospitals must invest large sums to have a team capable of delivering a fully staffed multidisciplinary team. However, with around half of geriatrician posts going unfilled in the UK there is
Table 2  Summary of primary outcomes reported in 13 included studies comparing CGA to standard care

| Primary outcome | Author, year | Surgery | No of participants | Description | Time point | Outcome of intervention group | Outcome of control group | Findings |
|-----------------|--------------|---------|-------------------|-------------|------------|------------------------------|-------------------------|----------|
| **Emergency Surgery** | | | | | | | | |
| | Kennie 1988<sup>31</sup> | Hip fracture | 108 | Physical independence- Katz index categories B-D | At hospital discharge | 75.6% | 46.2% | Favours intervention p=0.005 |
| | Marcantonio 2001<sup>32</sup> | Hip fracture | 126 | Total cumulative incidence of delirium during hospital stay (MMSE, DSI, MDAS, CAM) | During admission | 32% | 50% | No difference p=0.4 |
| | Huusko 2002<sup>16</sup> | Hip fracture | 260 | Length of stay | After successful discharge from any hospital for 2 weeks | 34 days (95% CI 28 to 38) | 42 days (95% CI 35-48) | No difference p=0.05 |
| | Naglie 2002<sup>33</sup> | Hip fracture | 280 | Proportion of patients alive with no decline in ambulation or transfers in and out of a chair or bed and no change in place of residence | 6 months after surgery | 39.7% | 34.1% | No difference |
| | | | | | | | | Difference 5.6%–95% CI 5.6 to 17% |
| | Vidan 2005<sup>36</sup> | Hip fracture | 321 | Length of stay | Discharge | 16 days | 18 days | Favours intervention p=0.06 |
| | Lundstrom 2007<sup>21</sup> | Hip fracture | 199 | No of days of postoperative delirium (DSM-IV criteria) | In-hospital | 5.0±7.1 | 10.2±13.3 | Favours intervention p=0.009 |
| | Deschodt 2011<sup>29</sup> | Hip fracture | 171 | Function status (6-item Katz Index) | In-hospital | Multiple time points reported | Multiple time points reported | No difference, except if measured on day 8 |
| | Taraldsen 2014<sup>55</sup> | Hip fracture | 397 | Mobility (short physical performance battery) | 4 months | 5.2 (SE0.20) | 4.38 (SE0.2) | Favours intervention Difference 0.74 (95% CI 0.18 to 1.30) p=0.010 |
| | Watne 2014<sup>37</sup> | Hip fracture | 329 | Cognitive performance (10 words test, CERAD battery, CDR scale, sum of boxes score) | 4 months | 54.7 | 52.9 | No difference |
| | | | | | | | | 95% CI −9.5 to 9.5 p=0.65 |
| | Shyu 2016*<sup>4</sup> | Hip fracture | 299 | Self care ability (recovery of IADL) | Up to 24 months | not reported | not reported | Favours intervention p<0.05 |
| **Elective surgery** | | | | | | | | |
| | Hempenius 2013<sup>41</sup> | Surgery for solid tumour | 297 | Delirium | Up to 10 days postoperatively | 9.4% | 14.3% | No difference |
| | | | | | | | | OR6.3 95% CI 0.29–1.35 |
| | Partridge 2017<sup>35</sup> | AAA repair or lower-limb arterial bypass | 209 | Length of stay | Discharge | 3.32 | 5.53 | Favours intervention Difference 0.6 (95% CI 0.46–0.79) p<0.001 |

Continued
a lack of workforce to deliver this service even if funded. As demonstrated here, the lack of standardisation in the components and timings in delivering does not aid in optimising the intervention to being as lean and effective as possible. Furthermore, this lack of clear intervention makes trials with associated health economic evaluations difficult to implement. This review has provided a basis on which to develop this intervention alongside MRC complex intervention guidelines and ensure that it is evaluated effectively, allowing for evidenced-based implementation.

This systematic review complements previous quantitative systematic reviews on CGA in perioperative populations. This is the first study to demonstrate the variation and similarities in how CGA is delivered across perioperative populations. Four electronic databases were searched, with reference lists also handsearched for further references, making it very unlikely any trials were missed. It presents the most up to date summary of all the evidence available on this topic so far and has also identified some upcoming trials from published protocols. Limitations include an inability to neatly present the data due to the variation discussed and that this review does not provide a quantitative answer of efficacy of CGA in a perioperative setting. However, it is unlikely a quantitative analysis would have been a useful addition due to the wide variation of CGA delivered as discussed above.

CONCLUSION

A consensus on how best to report, deliver and measure the efficacy of CGA in a perioperative setting does not currently exist. Further research is needed to optimise CGA in a perioperative setting to maximise its efficacy as a ‘complex intervention’. This will provide a consistent intervention to test in trials, evaluate its effect and economic impact, and ultimately implement clinically to benefit patients.

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REFERENCES

1. Fowler AJ, Abbott TEF, Prowle J, et al. Age of patients undergoing surgery. Br J Surg 2019;106:1015–8.

2. Miller RL, Barnes JD, Mouton R, et al. Comprehensive geriatric assessment in perioperative care: a protocol for a systematic review and qualitative synthesis. BMJ Open 2021;11:e049875.

3. NELA Project Team. Sixth patient report of the National emergency laparotomy audit, 2020. https://www.unicef.org.uk/reports

4. Earner G, Taheri A, Chen SS, et al. Comprehensive geriatric assessment for older people admitted to a surgical service. 2018, 2018.

5. Gardner M, Shepperd S, Godfrey M, et al. Comprehensive geriatric assessment in hospital and hospital-at-home settings: a mixed-methods study. Health Serv Deliv Res 2019;7:1–206.

6. Ellis G, Gardner M, Tsachristas A, et al. Comprehensive geriatric assessment for older adults admitted to hospital. Cochrane Database Syst Rev 2017;7.

7. Warren MW. Care of chronic sick. Br Med J 1943;2:822–3.

8. Braude P, Short R, Bouamra O, et al. A national study of 23 major trauma centres to investigate the effect of a geriatrician assessment on clinical outcomes in older people admitted with serious injury in England (FTR 2): a multicentre observational cohort study. Lancet Healthy Longev 2022;3:e549–57.

9. Craig P, Dieppe P, Macintyre S. Developing and evaluating complex interventions: new guidance. UK Medical Research Council 2008, 2011. www.mrc.ac.uk/complexinterventionsguidance

10. PRISMA. Transparent reporting of systematic reviews and meta-analyses, 2009. Available: http://www.prisma-statement.org/ [Accessed 6 Nov 2019].

11. Guise J-M, Butler ME, Chang C, et al. AHRQ series on complex intervention systematic reviews-paper 6: PRISMA-CI extension statement and checklist. J Clin Epidemiol 2017;90:43–50.

12. Covidence. Covidence - Better systematic review management. Available: https://www.covidence.org/ [Accessed 7 Sep 2020].

13. Higgins JPT, Altman DG, Gotzsche PC, et al. The Cochrane collaboration’s tool for assessing risk of bias in randomised trials. BMJ 2011;343:d5928.

14. Dixon-Woods M, Agarwal S, Young B, Integrative approaches to qualitative and quantitative evidence, 2004.

15. Hoffmann TC, Glasziou PP, Boutron I, et al. Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. BMJ 2014;348:g1687.

16. HuskTO TM, Karppi P, Avikainen V, et al. Intensive geriatric rehabilitation of hip fracture patients: a randomized, controlled trial. Acta Orthop Scand 2002;73:425–31.

17. HuskTO TM, Karppi P, Avikainen V, et al. Randomised, clinically controlled trial of intensive geriatric rehabilitation in patients with hip fracture: subgroup analysis of patients with dementia. BMJ 2000;321:1107–11.

18. Shyu Y-IL, Liang J, Tseng M-Y, et al. Comprehensive and subacute care interventions improve health-related quality of life for older patients after surgery for hip fracture: a randomised controlled trial. Int J Nurs Stud 2013;50:1013–24.

19. Shyu Y-IL, Liang J, Tseng M-Y, et al. Enhanced interdisciplinary care improves self-care ability and decreases emergency department visits for older Taiwanese patients over 2 years after hip-fracture surgery: a randomised controlled trial. Int J Nurs Stud 2016;56:54–82.

20. Stenvall M, Olofsson B, Nyberg L, et al. Improved performance in activities of daily living and mobility after a multidisciplinary postoperative rehabilitation in older people with femoral neck fracture: a randomized controlled trial with 1-year follow-up. J Geriatr Phys Ther 2007;30:232–8.

21. Lundström M, Olofsson B, Stenvall M, et al. Postoperative delirium in old patients with femoral neck fracture: a randomized intervention study. Aging Clin Exp Res 2007;19:178–86.

22. Stenvall M, Berggren M, Lundström M, et al. A multidisciplinary intervention program improved the outcome after hip fracture for people with dementia--subgroup analyses of a randomized controlled trial. Arch Gerontol Geriatr 2012;54:e284–9.

23. Taraldsen K, Sletvold O, Thingstad P, et al. Physical behavior and function early after hip fracture surgery in patients receiving comprehensive geriatric care or orthopedic care--a randomized controlled trial. J Gerontol A Biol Sci Med Sci 2014;69:338–45.

24. Prestmo A, Hagen G, Sletvold O, et al. Comprehensive geriatric care for patients with hip fractures: a prospective, randomised, controlled trial. Lancet 2015;385:1623–33.

25. Taraldsen K, Thingstad P, Sletvold O, et al. The long-term effect of being treated in a geriatric ward compared to an orthopaedic ward on six measures of free-living physical behaviour 4 and 12 months after a hip fracture - a randomised controlled trial. BMC Geriatr 2015;15.

26. Thingstad P, Taraldsen K, Saltvedt I, et al. The long-term effect of comprehensive geriatric care on gait after hip fracture: the Trondheim Hip Fracture Trial--a randomized controlled trial. Osteoporos Int 2016;27:933–42.

27. Hetline M, Saltvedt I, Lydersen S, et al. Patterns of drug prescriptions in an orthogeriatric ward as compared to an orthopaedic ward: results from the Trondheim hip fracture trial-a randomised clinical trial. Eur J Clin Pharmacol 2017;73:937–47.

28. Sletvold O, Helbostad JL, Thingstad P, et al. Effect of in-hospital comprehensive geriatric assessment (CgA) in older people with hip fracture. The protocol of the Trondheim hip fracture trial. BMC Geriatr 2011;11:1–10.

29. Deschmidt M, Braes T, Broos P, et al. Effect of an inpatient geriatric consultation team on functional outcome, mortality, institutionalization, and readmission rate in older adults with hip fracture: a controlled trial. J Am Geriatr Soc 2011;59:1299–308.

30. Hempenius L, Slaptops JPJ, van Asselt D, et al. Outcomes of a geriatric liaison intervention to prevent the development of postoperative delirium in frail elderly cancer patients: report on a multicentre, randomized, controlled trial. PLoS One 2013;8:e64834.

31. Kennie DC, Reid J, Richardson IR, et al. Effectiveness of geriatric rehabilitative care after fractures of the proximal femur in elderly women: a randomised clinical trial. BMJ 1988;297:1083–6.

32. Marcantonio ER, Flacker JM, Wright RJ, et al. Reducing delirium after hip fracture: a randomized trial. J Am Geriatr Soc 2001;49:516–22.

33. Naglie G, Tansey C, Arakld JL, et al. Effectiveness of interventional inpatient care for elderly people with hip fracture: a randomized controlled trial. CMAJ 2002;167:25–32.

34. Ommundsen N, Wyller TB, Nesbakken A, et al. Preoperative geriatric assessment and tailored interventions in frail older patients with colorectal cancer: a randomized controlled trial. Colorectal Dis 2018;20:16–25.

35. Partridge JSL, Harari D, Martin FC, et al. Randomized clinical trial of comprehensive geriatric assessment and optimization in vascular surgery. Br J Surg 2017;104:579–87.

36. Vidán M, Sierra JA, Morante C, et al. Efficacy of a comprehensive geriatric intervention in elderly patients hospitalized for hip fracture: a randomized, controlled trial. J Am Geriatr Soc 2005;53:1476–82.

37. Otto Watne L, Cathrine Torbergsen A, Conroy S. The effect of a pre- and postoperative orthogeriatric service on cognitive function in patients with hip fracture: randomized controlled trial (Oslo Orthogeriatric trial, 2014.

38. Wyller TB, Watne LO, Torbergsen A, et al. The effect of a pre- and postoperative orthogeriatric service on cognitive function in patients with hip fracture. The protocol of the Oslo Orthogeriatrics trial. BMC Geriatr 2012;12:1–13.

39. O’Donnell CM, Black N, McCourt KC, et al. Development of a core outcome set for studies evaluating the effects of anaesthesia on perioperative morbidity and mortality following hip surgery. J Clin Anaeth 2019;32:120–30.

40. Dolin TG, Mikkelsen M, Jakobsen HL. Geriatric assessment and intervention in older vulnerable patients undergoing surgery for
colorectal cancer: a protocol for a randomised controlled trial (GEPOC trial), *BMC Geriatr* 2021;21:1–10.

41 Mouchoux C, Rippert P, Duclos A, et al. Impact of a multifaceted program to prevent postoperative delirium in the elderly: the CONFUCIUS stepped wedge protocol. *BMC Geriatr* 2011;11:25.

42 Conroy SP, Bardsley M, Smith P. Health services and delivery research comprehensive geriatric assessment for frail older people in acute hospitals: the HoW-CGA mixed-methods study, 2019.

43 Results A. Available: https://www.webofscience.com/wos/woscc/analyze-results/229840b8-6154-4b9d-abd3-ce813fc7f3a3-0b2fe910 [Accessed 4 Oct 2021].

44 Sixth Patient Report - National Emergency Laparotomy Audit. Available: https://www.nela.org.uk/Sixth-Patient-Report#pt [Accessed 25 Oct 2021].

45 NELA project Team. Fifth patient NELA report of the National emergency laparotomy audit, 2019. Available: https://www.nela.org.uk/Fifth-Patient-NELA-Report#pt [Accessed 25 Oct 2021].

46 Focus on physicians: 2018–19 census (UK consultants and higher specialty trainees) | RCP London. Available: https://www.rcplondon.ac.uk/projects/outputs/focus-physicians-2018-19-census-uk-consultants-and-higher-specialty-trainees. [Accessed 11 Nov 2021].