Author’s response to reviews

Title: Fast track hip fracture care and mortality – an observational study of 2230 patients.

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Version: 1 Date: 15 Jan 2019

Author’s response to reviews:

Lørenskog, 14 January 2019

Response letter - BMC Musculoskeletal Disorders - BMSD-D-18-01322

We would like to thank both the editor and the reviewers for taking the time to evaluate our manuscript and for their constructive comments. We were glad to notice that both reviewers found our work to be interesting and we believe that, even though we did not observe significant effects of fast track hip fracture care on mortality, the manuscript contains important information for all health care personnel involved in hip fracture treatment. After considering all comments we decided to restrict our analysis to the two major groups, the ‘conventional treatment group’ and the ‘fast track group’. All concerns put forward in the reviewing process are addressed point by point in the following.

We have used ‘track changes’ to mark our changes in the revised manuscript. However, to keep the tables ‘readable’, changes in the revised tables and their footnotes have mainly been marked by highlighting the changes in yellow. Two new references that were included are also highlighted in yellow in the text.
Editor Comments:

1. Absence of evidence does not equal evidence of absence. The results presentation focuses on p-values and statistical significance, and these seem often to be misinterpreted. Please note that statistical significance refers to inferential uncertainty and that statistical non-significance does not indicate evidence of absence (just absence of evidence). For example (in abstract conclusions): “The introduction of fast track hip fracture care did not change the 30-day, 90-day or 1-year mortality”. An observed non-significance does not contradict the existence of a substantial difference in the population represented by the evaluated sample in the study. Please revise accordingly throughout manuscript.

Authors’ comments:

We agree, of course, that absence of evidence does not equal evidence of absence and have revised the manuscript accordingly.

Changes made:


Changed: “The introduction of fast track hip fracture care did not change the 30-day, 90-day or 1-year mortality.” to “… However, we observed no statistically significant change in 30-day, 90-day or 1-year mortality after the introduction of fast track hip fracture care.” (Abstract conclusions, lines 54-60, page 3)

Changed: “Although the introduction of fast track hip fracture care significantly reduced …, it did not change the 30-day, 90-day or 1 year mortality.” to “Although the introduction of fast track hip fracture care significantly reduced …, we observed no significant change in 30-day, 90-day or 1 year mortality.” (Discussion, lines 383-386, page 18)
Changed: “The length of hospital stay did not differ between the conventional treatment group and the fast track group.” to “The length of hospital stay did not differ significantly between the conventional treatment group and the fast track group.” (Discussion, lines 390-392, page 18)

Changed: “However, we performed a subgroup analysis of healthier patients, who can be expected to live in the community, and found no effect of fast track care on mortality.” to “However, we performed a subgroup analysis of healthier patients, who can be expected to live in the community, and found no statistically significant effect of fast track care on mortality.” (Discussion, lines 447-449, page 20)

Changed: “The introduction of fast track hip fracture care did not change the 30-day, 90-day or 1 year mortality.” to “… However, we observed no statistically significant change in 30-day, 90-day or 1-year mortality after the introduction of fast track hip fracture care. (Conclusions, lines 516-519, page 23)

2. How do you discriminate the effects of the actual time reduction (fast track management) from other changes in care, i.e. standardized perioperative treatment, systematic focus on nutritional status and prevention and treatment of delirium and mobilization?

Authors’ comments:

As you are pointing out, this is a limitation of the presented study. We attempted to discriminate the effect of the ‘fast track admission pathway’ from the other changes in care by analyzing the subgroup of patients who were admitted in less than 60 minutes. However, as pointed out by reviewer 1 and discussed in the answer to her main concern, there are methodological problems with this approach. We decided therefore to restrict our analysis to the two main groups.

Changes made:

Added: “The available data do not allow us to determine to what extent the different components of the reported fast track care system were applied to an individual patient. Therefore, the analysis follows the intention to treat principle and hip fracture patients treated from 28 October 2013 and onwards are included in the fast track group, irrespective of length of admission time or other criteria.” (Methods, Patients, lines 173-177, pages 7/8)
Added under limitations: “It is not possible to discriminate the effects of the different components of the described fast track care system.” (Discussion, lines 478-479 page 21)

3. You actually have 3 groups. Before 28 Oct 2013, 28 Oct 2013 to 26 Jan 2014 and after 27 Jan 2014. Please discuss the implication on results and ways of considering this in further analyses not foregoing power issues.

Authors’ comments:
To analyze the group of patients who were treated between 28 October 2013 and 26 January 2014 separately would result in a very small group with hence few events. In our view this would also make the manuscript more difficult to read. We considered excluding said patients. However, the fast track admission pathway is but one part of the whole fast track care system and excluding these patients did not change the results. We decided therefore to analyze all patients treated from 28 October 2013 and onwards as one group.

4. Please describe the inclusion criteria for the “Fast-track admission group” in detail in methods section (not only in abstract). This may help the reader to understand why less than 50% of patients with hip fracture were included in this group.

Authors’ comments:
As mentioned above and discussed in more detail in our next comment as well as in the response to reviewer 1, we decided to restrict the analysis to the two main groups.

Changes made:
The ‘fast track admission group’ is no longer analysed as a subgroup. For detailed changes please refer to the answer to the first comment by reviewer 1.

Please also elaborate (preferably also in a table) as to why only fewer than half of all patients were able to follow the “fast track”.
Authors’ comments:

An admission time of less than 60 minutes was chosen as a surrogate parameter of having followed the fast track admission pathway (as stated in the Methods section, lines 169-173, page 7 [now deleted]: “Those patients in the fast track group who required less than 60 minutes from arrival at the hospital to arrival at the orthopaedic ward were defined as having been admitted via the fast track admission pathway (fast track admission group).”) This cut-off was chosen somewhat arbitrarily, but based on the facts that a) fast track admission typically took about 30 to 45 minutes and b) that having used 59 minutes for admission would still imply that the patient did not follow the conventional admission pathway from A&E department to radiology department, back to A&E department and finally to the orthopaedic ward. However, this was just a surrogate parameter and we do not know if patients who used 75 minutes for admission still might have followed the ‘fast track admission pathway’. After new consideration, it is our view that this uncertainty constitutes an additional argument for dropping the ‘fast track admission group’ from the analysis, as suggested by reviewer 1.

We do not know why not all patients were admitted via the fast track admission pathway. Not having been admitted via the fast track admission pathway may have had both logistical reasons (such as unawareness by new employees, miscommunication etc.) and medical reasons (additional fracture, other more acute medical condition, etc.). Unfortunately, this data is not available.

To keep the flow of argumentation in the Discussion section after deleting the paragraph on the ‘fast track admission group’, the paragraph on the effect of admission time and preoperative waiting time was moved to the bottom of page 18.

Changes made:

Deleted: “Hence only 45 % of the patients in the fast track group were admitted via the fast track admission pathway as intended.” (Discussion, lines 395-396, page 18)

Added: “We do not know exactly how many patients were admitted via the fast track admission pathway, but the data on admission time would suggest that this was the case for only about half of the patients.” (Discussion, lines 399-401, page 18)

Added: “However, …” (Discussion, line 403, page 18)
Moved: “The importance of admission time for postoperative outcome is still controversial with shorter admission time being associated with higher in-hospital mortality in one study {Clague, 2002} and with fewer postoperative complications in another {Larsson, 2011}. The effect of preoperative waiting time on postoperative outcome is not unequivocal either {Moran, 2005}. However, an increasing body of evidence suggests that a longer time to surgery correlates with increased mortality {Pincus, 2017; Nyholm, 2015}, risk of infection {Westberg, 2013} and other complications {Al-Ani, 2008}.” (to: Discussion, lines 403-409, pages 18/19; from Discussion, lines 459-466, page 21)

Deleted: “In addition, …” (Discussion, line 410, page 19)

Added: “Data on admission time suggests that only about half of all patients in the fast track group were admitted via the fast track admission pathway. However, the expedient admission is only one of several components of a fast track hip fracture care system.” (Discussion, limitations, lines 479-482, pages 21/22)

5. Please present information on patients in the fast-track group that were not included in the fast-track admission group in table 1 (“Fast track group without fast track admission (n = 627)” as presented in table 6).

Authors’s comments:

As mentioned/discussed under point 2 and point 4 as well as under the first comment by reviewer 1, we now chose, in response to the main concern by reviewer 1, to restrict our analysis to the two main groups. The ‘fast track admission group’ is no longer analyzed as a subgroup and therefore the “Fast track group without fast track admission” is equally no longer mentioned as a subgroup.

Changes made:

Deleted: Column ‘fast track admission group’ in table 1 (Results, table 1, line 278, page 12);
“ a Subgroup of the fast track group” (Results, footnote to table 1, line 279, page 12)
6. Please describe which analyses that are equivalent to intention to treat (ITT) and which that are equivalent to per protocol (PP).

Authors’ comments:
In the submitted manuscript analyzing the ‘fast track group’ as a whole was equivalent to an intention to treat analysis while analyzing the ‘fast track admission group’ was equivalent to a per protocol analysis. However, as mentioned/discussed under point 2, point 4 and point 5 as well as under the first comment by reviewer 1, we now chose, in response to the main concern by reviewer 1, to restrict our analysis to the two main groups. The ‘fast track admission group’ is no longer analyzed as a subgroup.

Changes made:
The ‘fast track admission group’ is no longer analyzed as a subgroup. For detailed changes please refer to the answer to the first comment by reviewer 1.

Added: “The available data do not allow us to determine to what extent the different components of the reported fast track care system were applied to an individual patient. Therefore, the analysis follows the intention to treat principle and hip fracture patients treated from 28 October 2013 and onwards are included in the fast track group, irrespective of length of admission time or other criteria.” (Methods, Patients, lines 173-177, pages 7/8)

7. Please explain the statement on line 423-26 starting with “There were small, but due to the large number of patients …”. Where can the reader find these analyses?

Authors’ comments:
The distribution of the ASA-score categories, the categories for cognitive impairment, type of anesthesia and operating time are statistically different between the conventional treatment group and the fast track group. This information is now included in tables 1 and 2. Looking at the numbers, the differences are not overwhelming, but, due to the relatively large cohorts, they are statistically significant. However, in the logistic regression models “Other variables were included as confounders if they showed statistical significance at the 0.05 level, except for patient age and gender, which were always included.” (Methods, statistical analysis, lines 243-245, page 10), thereby adjusting these analyses for the between group differences of the co-variates.

The appropriate statistic tests used to compare the distribution of the variables of “baseline characteristics” and “surgical treatment” between the groups have also been added to the Methods section under ‘statistical analysis’.

Changes made:

Changed: “Fisher’s exact test was used for all unadjusted comparisons of proportions.” to “Fisher’s exact test was used for unadjusted comparisons of proportions, while the Chi square test was used for unadjusted comparisons of ordinal and nominal distributions.” (Methods, Statistical analysis, lines 233-234, page 10)

Changed: “Comparisons of admission times, time to surgery and length of hospital stay were made with non-parametric Mann-Whitney U tests, rather than t-tests, due to the skewed distributions of these variables.” to “Student’s T test was used for unadjusted comparisons of continuous variables. However, comparisons of admission times, time to surgery and length of hospital stay were made with non-parametric Mann-Whitney U tests, rather than t-tests, due to the skewed distributions of these variables.” (Methods, Statistical analysis, lines 235-238, page 10)

Changed: In table 1 and table 2 the fourth column, which was headed “Fast track admission group” has been replaced by a column with the heading “p-value” which gives the p-value for a test for equal distribution of the different variables in both groups (Student’s T-test for continuous variables and Chi square test for ordinal and nominal distributions). (Results, table 1, line 278, page 12 and table 2, line 288, page 13)
Added: “b Test for equal distribution in both groups (Student’s T-test for age, Chi square test for all other parameters) (Results, footnotes to table 1, lines 280-281, page 12)

Added: “b Test for equal distribution in both groups (Student’s T-test for operating time, Chi square test for all other parameters)” (Results, footnotes to table 2, lines 290-291, page 13)

8. Please in each results table describe the tests done, between which groups and the results in terms of difference with 95% confidence interval as to enable the reader to appreciate also the clinical significance.

Authors’ comments:

We have added the statistical tests that were applied to the footnotes of tables 4 and 5. Between which groups the tests were done is indicated by signs (*, #, ¥) in raised font in the tables and their footnotes. Since we now have restricted our analysis to the two main groups this will be easier for the reader to follow. Statistical differences between the two groups are still indicated by “*, # and ¥” in raised font and further explained in the footnotes. In table 3 and 4 the results are now also expressed in terms of difference with 95% confidence interval. We also added an explanation in the footnotes to table 5 concerning the two columns with subheading “n”, which represent the number of patients in each group for whom the variables were available.

The variables presented in table 5 are continuous, but skewed. Accordingly, they are expressed as medians with interquartile range and a non-parametric test was applied. Confidence intervals are not usually combined with non-parametric analyses.

Changes made:

Changed: In tables 3 and 4 we replaced the fourth column, which was headed “Fast track admission group” by a column with the heading “Between group differences” which presents the absolute difference in % with 95% confidence interval. Since some of the 95% confidence intervals contain two negative values, all hyphens in the confidence intervals in tables 3 and 4 were replaced by the word “to” in order to avoid a hyphen followed by a ‘minus-sign’. (Results, Mortality, table 3, line 313, page 14 and Results, Secondary outcome measures, table 4, line 349, page 16)
Reviewed: “(Fisher’s exact test, …)” (Results, Secondary outcome measures, footnotes to table 4, lines 354 and 356, page 16)

Reviewed: “(binary logistic regression)” (Results, Secondary outcome measures, footnotes to table 4, line 355, page 16)

Reviewed: “b Number of patients with available data” (Results, Admission time, time to surgery and length of hospital stay, footnotes to table 5, line 368, page 17)

Reviewed: “Mann Whitney U test” (Results, Admission time, time to surgery and length of hospital stay, footnotes to table 5, line 370, page 17)

Reviewed: “# Statistically significant difference (Mann Whitney U test, p < 0.0001)” (Results, Admission time, time to surgery and length of hospital stay, footnotes to table 5, line 371, page 17)

Reviewer reports:

Cecilia Rogmark (Reviewer 1): The study is within the scope of BMC Musculoskeletal disorders; it adds important knowledge on the much popular - but little evidence based - principles of fast track care for hip fracture patients. The setting of the study with public healthcare, well-functioning national registers and personal ID number is optimal for an observational study.

The major concern is, to me, that the authors pull out the patients with optimal fast track care and draw the final conclusion on them. That organizational obstacles lie in the way for a 100% functioning fast track are more the rule than the exception in everyday work. Therefore, I think the fast track group should be analyzed as a whole, at least in the main conclusions. That some patients with a particularly "lucky" path through the hospital will have better outcome is quite obvious.

Authors’ comments:
We agree with the reviewer. The ‘fast track admission group’ was defined arbitrarily using a cut-off of having used less than 60 minutes from arrival at the hospital to arrival at the orthopaedic ward. Having used ≥ 60 minutes for admission after the introduction of fast track care may have had logistic, but also medical reasons, such as a different, more acute medical condition. Thus, although we adjusted for measured confounders (age, gender, ASA-score, cognitive impairment) and tested for unmeasured confounding by also comparing the patients in the fast track group who used ≥ 60 minutes for admission with the conventional group (without finding statistically significant differences in any outcome), the ‘fast track admission group’ represents a selected group. Therefore, we dropped the ‘fast track admission group’ from the analysis and compare only the two major groups the ‘conventional treatment group’ and the ‘fast track group’.

Changes made:

Deleted: “Patients in the fast track group, who required less than 60 minutes from arrival at the hospital to arrival at the orthopaedic ward (fast track admission group), were analysed as a subgroup.” (Abstract methods, lines 33-35, page 2)

Deleted: “In the fast track admission group the composite 30-day outcome (reoperation, postoperative infection and/or death) was significantly less frequent (6.4 %) than in the conventional treatment group (10.7 %) (p = 0.006), also after adjusting for age, gender, cognitive impairment and ASA score (odds ratio = 0.61 (95%CI: 0.40 – 0.96), p = 0.03).” (Abstract results, lines 43-46, page 2)

Deleted: “The fast track admission group, who received the intended interventions to the greatest extent, had an improved composite 30-day outcome (reoperation, postoperative infection and/or death).” (Abstract conclusions, lines 58-60, page 3)

Deleted: “Those patients in the fast track group who required less than 60 minutes from arrival at the hospital to arrival at the orthopaedic ward were defined as having been admitted via the fast track admission pathway (fast track admission group). The fast track admission group was considered to represent a subgroup of the fast track group that received the intended interventions to the greatest extent.” (Methods, Patients, lines 169-173, page 7)

Deleted: “A subgroup of the fast track group (fast track admission group) was compared with the conventional treatment group.” (Methods, Subgroup analyses, lines 261-262, page 11)
Deleted: “… and the fast track admission group (subgroup of the fast track group)” (Results, lines 275-276, page 12)

Deleted: Column ‘fast track admission group’ in table 1 (Results, table 1, line 278, page 12);
“ a Subgroup of the fast track group” (Results, footnotes to table 1, line 279, page 12)

Deleted: “… and the fast track admission group (subgroup of the fast track group)” (Results, lines 285-286, page 13)

Deleted: Column ‘fast track admission group’ in table 2 (Results, table 2, line 288, page 13);
“ a Subgroup of the fast track group” (Results, footnotes to table 2, line 289, page 13)

Deleted: “In the fast track admission group 30-day mortality was significantly lower (5.1 %) than in the conventional treatment group (7.9 %) in an unadjusted analysis (p = 0.045) (table 3). However, after adjusting for age, gender, cognitive impairment and ASA score the odds-ratio (OR) for the fast track admission group was no longer significant (OR = 0.74 (95% confidence interval (95%CI): 0.45 – 1.21), p = 0.23, 7.8 % missing).” (Results, Mortality, lines 307-311, page 14)

Deleted: Column ‘fast track admission group’ in table 3 (Results, Mortality, table 3, line 313, page 14);
“ a Subgroup of the fast track group” (Results, Mortality, footnotes to table 3, line 314, page 14)
“* Statistically significant difference in unadjusted analysis (p = 0.045)” (Results, Mortality, footnotes to table 3, line 316, page 14)

Deleted: “… and the fast track admission group” (Results, Secondary outcome measures, line 325, page 15)
Deleted: “In the fast track admission group the composite 30-day outcome (reoperation, postoperative infection and/or death) was significantly less frequent (6.4 %) than in the conventional treatment group (10.7 %) in an unadjusted analysis (p = 0.006). After adjusting for age, gender, cognitive impairment and ASA score, the odds-ratio for the composite 30-day outcome remained in favour of the fast track admission group (OR = 0.61 (95%CI: 0.40 – 0.96), p = 0.03, 7.8 % missing).

To test for unmeasured confounding as a possible explanation for the improved composite 30-day outcome in the fast track admission group, the conventional treatment group was compared with the remaining patients in the fast track group who were not admitted via the fast track admission pathway. None of the outcomes differed significantly between the latter two groups neither in unadjusted nor adjusted analyses.” (Results, Secondary outcome measures, lines 337–347, pages 15/16)

Deleted: Column ‘fast track admission group’ in table 4 (Results, Secondary outcome measures, table 4, line 349, page 16);

“ a Subgroup of the fast track group” (Results, Secondary outcome measures, footnotes to table 4, line 350, page 16);

“* Statistically significant difference in unadjusted (p = 0.006) and adjusted analysis (odds ratio = 0.61 (95%CI: 0.40 – 0.96), p = 0.03, 7.8 % missing)” (Results, Secondary outcome measures, footnotes to table 4, lines 357-358, page 16)

Deleted: “Median admission time and time to surgery were significantly shorter in the fast track admission group compared to the remaining patients in the fast track group (table 6).” (Results, Admission time, time to surgery and length of hospital stay, lines 374-375, page 17)

Deleted: Table 6 (Results, Admission time, time to surgery and length of hospital stay, table 6, lines 377-380, page 17)

Deleted: “Hence only 45 % of the patients in the fast track group were admitted via the fast track admission pathway as intended. This subgroup, the fast track admission group, had a significantly improved composite 30-day outcome in both univariate and multivariate analysis and significantly reduced 30-day mortality in univariate analysis compared to the conventional treatment group.” (Discussion, lines 395-399, page 18)
Deleted: “… in the fast track group as a whole” (Discussion, line 403, page 18)

Deleted: “The fast track admission group had an improved composite 30-day outcome (reoperation, postoperative infection and/or death), indicating that fast track care given as intended had a positive effect. To assure that this improved outcome was not merely due to unmeasured confounding we confirmed that the remaining patients in the fast track group, who were not admitted via the fast track admission pathway, did not have a worse outcome than the conventional treatment group.

The fast track guidelines were applicable to the whole fast track group. Therefore, the main characteristic of the fast track admission group was the shorter admission time and waiting time to surgery compared to the remainder of the fast track group. This may have been the additional factor that resulted in the improved composite 30-day outcome.” (Discussion, lines 450-459, pages 20/21)

Deleted: “The improved composite 30-day outcome in combination with no increase in readmissions in the fast track admission group also seems to indicate that it is safe to “fast track” hip fracture patients to the orthopaedic ward after they have been triaged by trained health care personnel.” (Discussion, lines 467-469, page 21)

Deleted: “The patients who received the intended interventions to the greatest extent (the fast track admission group) had an improved composite 30-day outcome (reoperation, postoperative infection and/or death).” (Conclusions, lines 519-521, page 23)

Deleted: “(513 fast track admission group)b ” (Figure 1, from bottom right text-box in figure 1); “b Subgroup of the fast track group” (Legend to figure 1, line 577, page 25)

I also consider it remarkable that admission time is reported as a result in Table 6, when it in fact is the definition of Fast track admission group (<60 min).

Authors’ comments:
After restricting the analysis to the two main groups, this table is no longer relevant and has been deleted from the manuscript.

Changes made:

Deleted: Table 6 (Results, Admission time, time to surgery and length of hospital stay, table 6, lines 377-380, page 17)

I can’t understand in which group patients excluded due to medical conditions, high energy trauma, other fractures or neurovascular injury end up. Are they part of the control group, as they don't receive fast track care, or are they totally excluded from the current paper. How many are they? I think a more detailed information on this group, who may suffer higher risk of mortality, will increase the reader's chance to compare with other cohorts.

Authors’ comments:

Patients with other, more urgent medical conditions, who suffered high energy trauma or who presented with other fractures or neurovascular injury were excluded from the ‘fast track admission pathway’. However, all other changes in treatment (standardized perioperative treatment, systematic focus on nutritional status, prevention and treatment of delirium and early mobilization) were still applicable to these patients. Therefore, while these patients were not a part of the ‘fast track admission group’, they were still included in the ‘fast track group’ as a whole.

However, as discussed under editor’s comments, point 4 and reviewer 1’s comments, point 1, the ‘fast track admission group’ is no longer analyzed as a subgroup in the revised manuscript. To further clarify that no patients were excluded from the fast track group (other than those with pathological fracture and who were not reported to the Norwegian Hip Fracture Register, who were excluded from both groups) the following was added:

Changes made:

Added: “ The available data do not allow us to determine to what extent the different components of the reported fast track care system were applied to an individual patient. Therefore, the analysis follows the intention to treat principle and hip fracture patients treated from 28 October 2013 and onwards are included in the fast track group, irrespective of length of admission time or other criteria.” (Methods, Patients, lines 173-177, pages 7/8)
I think both the current paper - to some extent - and the cited literature are influenced by temporal trends. The mean time to surgery in the control group of 25 hrs are low in comparison to national standard in many countries, and lowering it to 23 hrs doesn't make that big differences. I.e. the conventional care in Norway in the 2010s seems to be of such high standard that there is little room for improvement. One can compare to Pedersen's study from Denmark, conducted 2003-2004 starting with the improvable LOS 15 days and 1-year-mortality of 29%.

Authors’ comments:

We agree with the reviewer. We already stated in the discussion section that “Other recent approaches to improve hip fracture care, such as geriatric co-management, have also largely failed to decrease mortality {Friedman, 2009; Watne, 2014; Eamer, 2018} underlining the fact that it is difficult to significantly reduce mortality in this frail group of patients.” We have modified this / added a sentence to emphasise this point in agreement with the reviewer’s comment.

Changes made:

Changed: “Other recent approaches to improve hip fracture care, such as geriatric co-management, have also largely failed to decrease mortality {Friedman, 2009; Watne, 2014; Eamer, 2018} underlining the fact that it is difficult to significantly reduce mortality in this frail group of patients.” to “One also has to consider the possibility that the continuous improvement of in-hospital hip fracture care has resulted in mortality rates for this frail group of patients which become increasingly difficult to reduce. This notion seems to be supported by the fact that also other recent approaches to improve hip fracture care, such as geriatric co-management, have largely failed to decrease mortality {Friedman, 2009; Watne, 2014; Eamer, 2018}.” (Discussion, lines 421-426, page 19)

Regardless of the authors agree on this speculation or not, a bit more clinical perspective would add value to the paper. Should we bother to do fast-track? Can we improve hip fracture care by other means?

Authors’ comments:

We agree that we could be clearer on the clinical relevance of our results.
Changes made:

Added: “We observed no increase in complications or readmissions after the introduction of fast track care which seems to indicate that “fast tracking” hip fracture patients to the orthopaedic ward after triage by trained health care personnel is safe. Even though fast track care did not significantly change mortality in this study, there was a numerical trend to improvement for all outcome measures and fast track care for hip fracture patients is still in place at our institution. Efforts to further improve hip fracture care should probably focus on even shorter preoperative waiting times {Pincus, 2017} in combination with a fast track care system and intensified rehabilitation after hospital discharge {Hansson, 2015}.” (Discussion, lines 506-513, page 23)

Reoperations and infections: As reoperation reporting to the NHFR were only 2/3 for internal fixation and infection were not gathered for internal fixation of femoral neck fractures, why didn't the study include a search of the medical records for these important complications?

Authors’ comments:

We agree with the reviewer that it would have been desirable to have this information. We attempted a search by procedure-code to identify reoperations in the electronic hospital records. However, this proved to be difficult and rendered data of a quality that was judged to be inferior to the data available from the Norwegian Hip Fracture Register. For a search of the records ‘by hand’ the required time and resources (2230 patient records) were deemed to not be justified by the extent of information that possibly could have been gathered. With respect to deep surgical site infection after screw osteosynthesis of femoral neck fractures, this is a very rare complication and we believe that neither an electronic search nor a search ‘by hand’ would have yielded results that would have changed the study’s conclusions.

The different degree of completeness for different procedures could at least be discussed, limitation?

Authors’ comments:

We agree with the reviewer that the inferior reporting rate of reoperations to the Norwegian Hip Fracture Register and the lack of follow-up for surgical site infection after screw osteosynthesis of femoral neck fractures should be mentioned under the study’s limitations. This is already the
case with respect to reoperations. We state that “In 2013 and 2014 the reporting rate from our institution was 66% for reoperations after osteosynthesis and 81.6% for reoperations after hemiarthroplasty {Furnes, 2017}.” in (Methods, Outcome measures, Reoperations, lines 196-197, page 8) and discuss this as a limitation: “The reporting rate of reoperations to the NHFR is inferior to the reporting rate of primary operations {Furnes, 2017}. Nevertheless, there is no reason to believe that the reporting rate of reoperations changed during the study period. Thus, the crude number of reoperations is probably higher than reported in this study, but the risk differences between the groups of patients studied should not be influenced by under-reporting of reoperations in only one of the groups.” (Discussion, limitations, lines 488-493, page 22)

However, the lack of follow-up for surgical site infection after screw osteosynthesis of femoral neck fractures was only mentioned in the Methods section (“Internal fixations of femoral neck fractures are not systematically surveyed for postoperative infection.”; Methods, postoperative infection, lines 209-210, page 9) We added this to the limitations.

While rereading these parts of the manuscript we realized that we failed to mention that intramedullary nails are not routinely followed up for postoperative infection either. This information was added in the Methods section and under limitations in the discussion.

Changes made:

Added: “Internal fixations of femoral neck fractures and intramedullary nails are not systematically surveyed for postoperative infection.” (Methods, Postoperative infection, lines 209-210, page 9)

Added: “While postoperative infections after hemiarthroplasty and total arthroplasty of the hip were followed up after 30 days and one year, sliding hip screws were only followed up after 30 days and internal fixations of femoral neck fractures and intramedullary nails were not followed up for this complication. However, this procedure specific difference in follow-up for postoperative infection applies equally to both the conventional treatment group and the fast track group.” (Discussion, limitations, lines 493-498, page 22)

To conclude; as much as I understand that the authors are eager to show a benefit of the fast-track concept (is it a post-hoc analysis of the "fast track admission group"?), maybe the continuous improvement of hip fracture care in Scandinavia during the last 15 years is the plausible explanation for the negative result in both this and other contemporary studies* over the topic? If the authors agree this may be added to the Discussion.
Authors’ comments:

We agree with the reviewer that the continuous improvement of hip fracture care in industrial countries, and in Scandinavia in particular, during the last one or two decades can have contributed to the fact that we and other contemporary studies did not find significant effects of fast track care systems on mortality after hip fracture. We added the reference that reviewer 1 refers to and added/changed a statement about the difficulty of further improving hip fracture care.

Changes made:


Changed: “Other recent approaches to improve hip fracture care, such as geriatric co-management, have also largely failed to decrease mortality {Friedman, 2009;Watne, 2014;Eamer, 2018} underlining the fact that it is difficult to significantly reduce mortality in this frail group of patients.” to “One also has to consider the possibility that the continuous improvement of in-hospital hip fracture care has resulted in mortality rates for this frail group of patients which become increasingly difficult to reduce. This notion seems to be supported by the fact that also other recent approaches to improve hip fracture care, such as geriatric co-management, have largely failed to decrease mortality {Friedman, 2009;Watne, 2014;Eamer, 2018}.” (Discussion, lines 421-426, page 19)

Added: “While in-hospital care is undoubtedly a cornerstone of hip fracture treatment, improvements in rehabilitation in the primary health care sector might also be warranted {Hansson, 2015}.” (Discussion, lines 426-428, page 19)

Changed: “While both Eriksson et al. {Eriksson, 2012} and Larsson et al. {Larsson, 2016} focused on bypassing the A&E department to reduce time to surgery, …” to “While Eriksson et al. {Eriksson, 2012}, Larsson et al. {Larsson, 2016} and Hansson et al. {Hansson, 2015} focused on bypassing the A&E department to reduce time to surgery, …” (Discussion, lines, 430-432, pages 19/20)

A Garland (Reviewer 2): Thank you for giving me the opportunity to review this interesting paper.

Scientific methodology: This is a classical retrospective observational study aiming to assess whether the introduction of a fast track hip fracture care reduced the 30-day mortality in Akershus University Hospital. Exposed fast track management (n=1140) and controls - conventionally treated (n=1090) were collected from 1 Jan 2012 to 31 Dec 2015 through the Norwegian Hip Fracture Register and reviewing hospital records. Fishers exact test was used and logistic regression models included factors judged to be relevant. Level of significance was set at p=0.05/95% CI. No power calculations were presented.

Suggestions:
- I humbly suggest a shortening of the manuscript. It is a fairly simple research question that ought to be possible to answer in fewer words.

Authors’ comments:
We are aware of the fact that the Methods section is quite extensive. However, we aimed to a) describe the entire fast track care system to make a comparison with other fast track care systems possible and b) report in detail how and from what source the different data were obtained to allow the reader to better judge their validity. Nonetheless, restricting our analysis to the two major groups has somewhat shortened the revised manuscript.

Changes made:

For details on which parts of the manuscript that have been deleted please refer to our answer to the first comment by reviewer 1.

- Is the year of surgery included in the analyses? Probably not of relevance with such a short observational period, but otherwise better results of any kind could potentially be explained by the general improvement in care during the same time period with all the unexposed collected in the beginning of the study period if I understand you correctly. You are reasoning some about it in the discussion section, the fact that you already before the introduction of the fast track had seen an improvement. This could be elaborated.

Author’s comments:

As already mentioned by the reviewer the observation period was rather short. The conventional treatment group was by and large treated during 2012 and 2013, the fast track group was by and large treated during 2014 and 2015. Including year of surgery in the analysis is therefore quasi equivalent to including before/after introduction of fast track care as a covariate and it would not be advisable to include both covariates in the same multivariate model.

We also discussed the fact that there already was an improvement in the 30-day mortality rate before the introduction of fast track care: “In addition, 30-day mortality decreased considerably during the two years before fast track care was introduced and subsequently levelled off. This would have made it difficult to detect a possible effect of fast track care on mortality. What caused this improvement is unclear. The preparations to introduce fast track care started in 2012 and one could speculate that the increased focus on hip fracture patients may have had a positive effect already before fast track care was taken into practice. Another possible scenario is that the introduction of fast track care had a negative effect and interrupted a positive time trend of decreasing mortality. However, this seems less likely since the 30-day mortality levelled off at a value that lies in the lower range of reported rates {Sheikh, 2017; Bretherton, 2015; Klop, 2014; Pincus, 2017}.” (Discussion, lines 410-420, page 19)
We have added a comment on the sample size calculation (see also our comments to the next point) to this part of the discussion.

Changes made:

Changed: “In addition, 30-day mortality decreased considerably during the two years before fast track care was introduced and subsequently levelled off. This would have made it difficult to detect a possible effect of fast track care on mortality.” to “Our sample size calculation was based on our institution’s 30-day mortality rate in 2011. However, 30-day mortality decreased considerably in 2012 and 2013, before fast track care was introduced, and subsequently levelled off. Thus, our sample size calculation was based on a higher mortality rate in the conventional treatment group than we did observe, which would have made it difficult to detect a possible effect of fast track care on mortality.” (Discussion, lines 410-415, page 19)

- I miss a presentation of your power calculations. How many patients would be needed to be included in the study in order to capture the differences in mortality you are aiming to capture? You are correctly questioning the results by Pedersen et al. on the same grounds without presenting the numbers needed to defend the results of your own study.

Authors’ comments:

We performed a sample size calculation before the start of the study, based on the 30-day mortality rate for hip fracture patients operated at our institution in 2011. This information was available from the Norwegian Institute of Public Health. We calculated the sample size required to have 85% power to detect a decrease in 30-day mortality from 10.7 % (our institution in 2011) to 6.8 % (hospital with lowest 30-day mortality in Norway in 2011).

We agree with the reviewer that this is important information and present our initial sample size calculation as well as a post hoc power calculation in the revised manuscript. We have also mentioned this in the revised version of the Discussion section.

Changes made:

Added: “A sample size calculation based on a reduction of the 30-day mortality rate after hip fracture from 10.7 % (AHUS in 2011 {Helgeland, 2013}) to 6.8 % (hospital with lowest mortality rate in Norway in 2011 {Helgeland, 2013}), 85 % power and a level of significance of
0.05 yielded a total sample size of approximately 1800 patients {Altman, 1991}. (Methods, Statistical analysis, lines 229-232, page 10)

Added: “A post hoc power analysis was performed using standard normal distribution approximation.” (Methods, Statistical analysis, line 256, page 11)

Added: “A post hoc power analysis, given the sample size and the observed 30-day mortality rate of 7.9 % in the conventional treatment group, showed that the study had 80 % power to detect a decrease of the 30-day mortality rate to 5.0 % in the fast track group with a level of significance of 0.05.” (Results, Mortality, lines 318-321, page 15)

Changed: “In addition, 30-day mortality decreased considerably during the two years before fast track care was introduced and subsequently levelled off. This would have made it difficult to detect a possible effect of fast track care on mortality.” to “Our sample size calculation was based on our institution’s 30-day mortality rate in 2011. However, 30-day mortality decreased considerably in 2012 and 2013, before fast track care was introduced, and subsequently levelled off. Thus, our sample size calculation was based on a higher mortality rate in the conventional treatment group than we did observe, which would have made it difficult to detect a possible effect of fast track care on mortality.” (Discussion, lines 410-415, page 19)

- What is the most interesting result of your study- the clinical implication? That the introduction of fast track didn't improve mortality or the fact that, if you do the fast track correctly the patients who receive the intended interventions to the greatest extent had an improved composite 30-day outcome? And is that reflected in title and abstract in the way you want it to be? When I read your study I tend to draw the clinical conclusion that if you are gonna fast track hip fracture patients do it properly or you'll loose the effect. But you don't? Or do you? Please elaborate on clinical implications.

Authors’ comments:

As mentioned/discussed under point 2 and point 4 raised by the editor as well as under the first comment by reviewer 1, we now chose, in response to the main concern by reviewer 1, to restrict our analysis to the two main groups and the ‘fast track admission group’ is no longer analyzed as a subgroup.
We believe that we have good evidence that “fast tracking” hip fracture patients to the orthopaedic ward after triage is safe since there was a numerical trend to improvement for all outcomes and we did not observe increased readmissions. This was added as a conclusion. However, since the main aim of the study was to investigate if the introduction of fast track care could reduce 30-day mortality after hip fracture, the main conclusion remains that we did not observe a statistically significant change in mortality.

We moderated the title and modified the results and conclusions sections in the abstract as well as the conclusions section. To elaborate on clinical implications, we added a paragraph at the end of the Discussion section.

Changes made:


Added: “A composite 30-day outcome (reoperation, postoperative infection and/or death) was significantly less frequent in the fast track group (8.1 %) than in the conventional treatment group (10.7 %) in unadjusted analysis (p = 0.006), but not after adjusting for age, gender, cognitive impairment and ASA score (odds ratio = 0.85 (95%CI: 0.63 – 1.16), p = 0.31, 8.0 % missing). Reoperations within 1 year, postoperative infections, 30-day readmissions and length of hospital stay did not differ significantly between the conventional treatment group and the fast track group.” (Abstract results, lines 46-53, page 2/3)

Changed: “The introduction of fast track hip fracture care did not change the 30-day, 90-day or 1-year mortality. The fast track admission group, who received the intended interventions to the greatest extent, had an improved composite 30-day outcome (reoperation, postoperative infection and/or death).” to “Fast track hip fracture care is safe. However, we observed no statistically significant change in 30-day, 90-day or 1-year mortality after the introduction of fast track hip fracture care.” (Abstract conclusions, lines 54-60, page 3)

Added: “We observed no increase in complications or readmissions after the introduction of fast track care which seems to indicate that “fast tracking” hip fracture patients to the orthopaedic ward after triage by trained health care personnel is safe. Even though fast track care did not significantly change mortality in this study, there was a numerical trend to improvement for all
outcome measures and fast track care for hip fracture patients is still in place at our institution. Efforts to further improve hip fracture care should probably focus on even shorter preoperative waiting times {Pincus, 2017} in combination with a fast track care system and intensified rehabilitation after hospital discharge {Hansson, 2015}.” (Discussion, lines 506-513, page 23)

Changed: “The introduction of fast track hip fracture care did not change the 30-day, 90-day or 1 year mortality. The patients who received the intended interventions to the greatest extent (the fast track admission group) had an improved composite 30-day outcome (reoperation, postoperative infection and/or death).” to “Fast track hip fracture care is safe. However, we observed no statistically significant change in 30-day, 90-day or 1-year mortality after the introduction of fast track hip fracture care.” (Conclusions, lines 516-521, page 23)

Additional changes made:

Changed: “Asbjørn Åroen” to “Asbjørn Årøen” (Title page, authors, line 5, page 1)

Authors’ comment: The family name of the senior author was misspelled.

Changed: “… , surgeon’s experience (< or ≥ 3 years of experience in hip fracture surgery) …” to “… surgeon’s experience (at least one surgeon with > 3 years of experience in hip fracture surgery).

Authors’ comment: The new wording is the correct translation of the text in the registration form. (Methods, Data collection, lines 144-145, page 6)

Changed: “The completeness of the 30-day follow-up ranged from 98.5 % to 99.6 % per calendar year.” to “The completeness of the 30-day follow-up ranged from 97.7 % to 99.6 % per calendar year. (Methods, Postoperative infection, line 206, page 9)

Authors’ comment: The new figure is the correct value. We realized that an error had occurred when transferring the numbers from a table.

Changed: Marginal changes in numbers for type of operation in table 2 (surgical treatment) and addition of ‘Resectionarthroplasty’ as a category (1 patient) (Results, table 1, line 278, page 12)
Authors’ comment: The information on the type of operation was missing for only 9 patients. These patients were identified in the database and the type of operation was gathered from the electronic hospital records.

Changed: “… significantly reduced the time to arrival at the orthopaedic ward, …” to “… significantly reduced admission time, …”. (Discussion, lines 383-384, page 18)

Authors’ comment: Admission time is defined in the Methods section under ‘Admission time, time to surgery and length of hospital stay’ (Methods, Admission time, time to surgery and length of hospital stay, line 224, page 10).

Changed: The lay-out of figure 1 was slightly changed: all text-boxes under the first box were moved to the left. (Figure 1)

Authors’ comment: This has made the figure slightly narrower and the first 4 text-boxes now align to the right.

Sincerely,

Christian Thomas Pollmann, Jan Harald Myhreng Røtterud, Jan-Erik Gjertsen, Fredrik Andreas Dahl, Olav Lenvik and Asbjørn Årøen