De-implementation of low-value care in hip and knee arthroplasty

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Chapter 10

Summary and General discussion

This thesis aimed to evaluate the effectiveness of a de-implementation strategy to reduce the use of blood salvage techniques (blood salvage) and preoperative treatment with erythropoietin (EPO) in primary elective hip and knee arthroplasty (THA and TKA).

Blood salvage and EPO are used to reduce the need for allogeneic red blood cell transfusion in patients undergoing elective orthopaedic surgery. However, it is considered to be low-value care, as previous research demonstrated that their use led to increased costs and had limited beneficial effects. This thesis described the stepwise de-implementation (i.e. the abandoning of low-value care) of these techniques according to the implementation model of Grol.[1] The first step described in this thesis was the development of concrete targets for the de-implementation of blood salvage and EPO in THA and TKA. For this purpose, the evidence that is currently available on the effectiveness of blood salvage and EPO was evaluated by means of two meta-analyses. It was followed by an analysis of current performance, target group and setting. Based on this information we developed a comprehensive strategy for de-implementation of low-value patient blood management (PBM) techniques which was followed by the execution and evaluation of this strategy using a cluster-randomized controlled trial.

This chapter starts with a summary of the main findings of the previous chapters. Subsequently these findings and relevant methodological issues are discussed in the light of available literature and finally recommendations for future practice and research are given.

Main Findings

The structure of this thesis is related to the model of Grol including: 1) the development of concrete targets for de-implementation of blood salvage and EPO in THA and TKA, 2) an analysis of current performance, targets group and setting in a problem analysis study, 3) the development of a de-implementation strategy, 4 and 5) the execution and evaluation of the developed de-implementation strategy.

Concrete targets for de-implementation (step 1)

The starting point for de-implementation is the development of concrete targets for de-implementation of blood salvage and EPO in THA and TKA. For this purpose, evidence is needed that proves that blood salvage and preoperative treatment with EPO in patients undergoing orthopaedic surgery is low-value care.

A systematic review including a meta-analysis on blood salvage in THA and TKA patients was presented in **Chapter 2**. The main aim of the systematic review was to assess the effectiveness of blood salvage on the reduction of allogeneic red blood cell transfusion, separately in THA and TKA patients, and to examine whether the results of recent trials would change the conclusions from previous meta-analyses. Forty-three trials (5631 patients) were included. Overall, blood salvage was found to reduce allogeneic transfusion in THA and TKA patients. However, trials with a low risk of bias published from 2010 to 2012 showed no significant effect of blood salvage on the rate of allogeneic blood transfusion nor the volume of transfused blood in neither THA nor TKA patients. These results suggest that other factors have changed over time such as the introduction of more restrictive transfusion thresholds, awareness of intra-operative blood loss, improved surgical techniques and the introduction of new modalities to reduce blood loss while the blood salvage product and the indication to use blood salvage remained unchanged.

A systematic review including a meta-analysis on EPO in THA and TKA was presented in **Chapter 3**. The primary aim was to assess the effectiveness of EPO on the reduction of allogeneic red blood cell transfusion in THA and TKA separately, secondary aims were to evaluate safety and costs. Seven trials (2439 patients) were included. EPO was found to reduce the exposure rate to blood transfusion in both THA and TKA and the volume of transfused blood (unable to split for hip/knee). No differences in thrombo-embolic or adverse events were found. Only one study evaluated costs, whereby no pooled estimates could be given for cost-effectiveness. The costs in this study were estimated at an additional €785 per patient or €7300 per avoided allogeneic transfusion (estimates may differ in other healthcare systems). Overall, the use of EPO was found to be effective and safe. However, the decision to use EPO on a routine base should be balanced against the costs, which are high.

Based on the results of the meta-analyses, we consider blood salvage and EPO as low-value care.

Analysis of current performance, target groups and setting (step 2).

The second step for the de-implementation of low-value care, with reference to the model of Grol, was a problem analysis study in which current performance, target group and setting for the use of blood salvage and EPO are explored. The protocol for this problem analysis is described in **Chapter 4**.

In **Chapter 5** a survey among Dutch orthopaedic departments was performed to assess the current use of low-value PBM techniques. The survey evaluated the frequency of use of various types of PBM of Dutch orthopaedic departments. Responders reported on a 5-

point Likert scale (never, almost never, regularly, almost always, always) how frequent a technique was used. The answers were divided into non-frequent use (never and almost never) and frequent use (regularly, almost always and always). The survey, completed by 81 Dutch orthopaedic departments (response rate 82%), showed that in 2012 intra-operative cell-savers were frequently used in 25 departments (31%), post-operative drainage and reinfusion of salvaged blood was used in 56 departments (69%) and EPO was frequently used at 55 departments (68%). When departments were compared on the basis of size, frequent EPO use was more common in large departments, with 22 (88%) large departments being frequent users versus 13 (63%) small departments and 16 (55%) intermediate departments, p = 0.03. No differences by size or type of department were observed for other techniques. Based on this survey, a target group of frequent users was identified. These frequent users were then invited to participate in the cluster-RCT.

In **Chapter 6** we evaluated whether specific outcome measures regarding PBM are suitable to compare the quality of care for THA and TKA patients between hospitals to be used by e.g. the health care inspection. In other words, we evaluated whether it is reliable to rank hospitals on the outcome measures 'allogeneic transfusion' and 'extended length of stay' (defined as postoperative stay >4 days) in patients undergoing THA and TKA. We did this by assessing which part of the observed variation between hospitals is due to true differences and which part is noise. Furthermore, we evaluated which factors are associated with the true hospital differences. To perform this evaluation, we first ranked hospitals based on Observed/Expected (O/E) ratios for the outcome measures 'allogeneic transfusion' and 'extended length of stay'. Observed variation between hospitals was assessed by calculating the rankability, a measure that expresses the reliability of ranking. Medical records from 1163 THA patients and 986 TKA patients from 23 hospitals were analysed. Rankability, expressed in a percentage of the existing variation based on differences between hospitals as compared to random variation, was low for the outcome allogeneic transfusion (21% in THA and 34% in TKA). The variation explained by hospital differences for the outcome extended length of stay was higher (71 % in THA and 78% in TKA), and therefore ranking based on extended length of stay is more reliable. Hospitals using local infiltration analgesia (LIA) and tranexamic acid (TXA) had relatively fewer patients with transfusions and extended length of stay, therefore they were associated with better performance of hospitals.

In **Chapter 7** a combined qualitative-quantitative study on barriers for de-implementation of low-value PBM techniques in THA and TKA was done. This study aimed to identify barriers associated with the intention of physicians to stop using blood salvage and EPO. Semi-structured interviews with 10 orthopaedic surgeons and 10 anaesthesiologists were conducted, followed by a questionnaire completed by 153 orthopaedic surgeons (response rate 40%) and 100 anaesthesiologists (response rate 27%). Identified barriers

corresponding with domains of the Theoretical Domains Framework (TDF)[2,3] were linked to the intention to stop either blood salvage or EPO. This resulted in a number of barriers within the domains 'social influences', 'motivation and goals' and 'beliefs about consequences' related to the intention to stop EPO and barriers within the domains 'social influences', 'motivation and goals', 'beliefs about consequences' and 'knowledge' related to the intention to stop blood salvage.

Development of a de-implementation strategy (step 3)

Following the analysis of current performance, target groups and setting, a strategy to reduce the use of blood salvage techniques and preoperative treatment with EPO in patients undergoing primary elective THA and TKA was developed which was geared at the barriers identified in **chapter 7**. This corresponds to the third step of the model of Grol.

Chapter 8 describes the developed de-implementation strategy. In the development process we selected behavioural change-techniques that are deemed to be effective in targeting the identified barriers[4] This resulted in a de-implementation strategy with four separate components:

1) the provision of information with a letter sent by email to all involved parties in the use of blood salvage and EPO, with an overview of the current literature.

2) Interactive education for the study participants (orthopaedic surgeons and anaesthesiologists) with an overview of the literature about blood salvage and EPO in THA and TKA. A summary is printed on a pocket card. Data on their blood management use and patient outcomes are presented and discussed.

3) Feedback during educational outreach visits aimed at study participants. A comparison is made over time between their current practice and their practice at baseline towards blood salvage, EPO, allogeneic transfusions and length of stay (LoS).

4) Electronic newsletter for study participants, sent twice. A comparison is made between participants' current practice and 'best practice' Benchmark hospitals (Dutch hospitals that do not use blood salvage or EPO) to emphasize safety.

Execution and evaluation of the developed de-implementation strategy (step 4 and 5)

The fourth and fifth step in the model of Grol were to execute and evaluate the developed de-implementation strategy. In **Chapter 9** the effectiveness of this theoretically-informed multifaceted strategy to de-implement low-value PBM techniques was evaluated by means of a multicentre cluster-randomized controlled trial. The exposure rate of patients

to blood salvage and EPO was measured before and after the strategy was carried out. By randomisation it was determined which hospitals received the intervention and were exposed to the strategy and which hospitals were controls. 21 hospitals were included. Before the intervention at baseline data of 924 patients in intervention hospitals and 1040 patients in control hospitals were analysed. After the intervention the data of 997 patients in the intervention hospitals and 1096 in control hospitals were analysed. The use of blood salvage and EPO reduced significantly over time, but it did not differ between intervention and control hospitals. The intervention hospitals had significantly higher postoperative haemoglobin levels compared with control hospitals and a greater reduction in length of stay. Allogeneic transfusions were comparable. In the process evaluation we noticed that the increased use of LIA and TXA was strongly associated with the reduction in blood salvage over time. This latter suggests that the de-implementation was assisted by the substitution of PBM techniques.

Discussion of the main findings

This thesis focused on the de-implementation of low-value PBM care. It is the first study that promotes the specific de-implementation of blood salvage and EPO in orthopaedic practice. It is therefore a pioneering study in a new field. The strengths of this thesis are the stepwise approach of de-implementation and the testing of the developed de-implementation strategy in a cluster-randomised trial that included a control group.

Theoretical underpinning of de-implementation strategies

For the stepwise approach the 5-step implementation model of Grol[1] was used. This led to a tailored strategy for de-implementing two low-value care topics, the use of blood salvage and EPO in primary elective orthopaedic surgery. De-implementation studies in general are not always preceded by a problem analysis study that gives insight into the relevant barriers and facilitators for the specific case, nor substantiated by a theoretical model. This is illustrated by the 39 de-implementation efforts that are described in the scoping review of Niven.[5] Of these studies, 26 do not describe a specific intervention to facilitate de-implementation. Of the 13 studies that did describe an intervention, 9 concerned market withdrawal of specific medications, which is in fact a very effective way of de-implementation, but not widely applicable (in these 9 studies a drug was withdrawn because patient safety was at stake). In the remaining 4 de-implementation studies, 3 did not describe a preceding problem analysis[6-8] and one used a problem analysis only to identify frequent users of low-value care.[9] Of these 4 studies only one reported why their used interventions were chosen.[6]

If we regard the literature on de-implementation efforts that are more closely related to the topic of this thesis, the de-implementation of inappropriate allogeneic transfusions, there is extensive literature available. Modern (international) transfusion guidelines advise a restrictive transfusion trigger with a threshold of 7-8 g/dL (4.3-5.0 mmol/l) for hemodynamic stable patients, as opposed to the fairly liberal threshold of 10 g/dL (6.2 mmol/l) by Adams and Lundy in 1942.[10-12] Several studies from all over the world report overuse or inappropriate use of transfusions.[13-19] Additionally, inappropriate use of transfusion is addressed by 'Choosing wisely', a campaign that supports de-implementation of low-value care in the USA[20] and it is addressed in the UK where appropriate use of transfusions has been audited by the National Comparative Audit of Blood Transfusion (NCABT) programme.[21] As de-implementation often does not happen by itself, the awareness of inappropriate use should be translated into action to change this.[22-24] A systematic review published in 2002 by Wilson et al. described which interventions were effective to change transfusion practice. Nine studies published between 1988 and 2000 were included. It was concluded that interventions identified as being generally effective to change behaviour included educational outreach visits, interactive educational meetings, reminders and multifaceted strategies[25] (corresponding to the strategy used in this thesis). A systematic review of interventions to change physicians' transfusion behaviour published by Tinmouth et al. in 2005[26], included 19 studies published between 1974 and 2004, concluding that multifaceted strategies did not lead to greater reductions in transfusions than studies with single interventions. It was additionally concluded that interventions with immediate feedback did not result in greater reductions than indirect feedback. In short, both reviews suggest which type of interventions can be effective, however they do not reach the same conclusions as to which interventions are most effective. This may suggest that the effects do not only depend on the type of intervention, but also on the presence of barriers and facilitators relevant to the topic and whether the chosen interventions are tailored to the present barriers and facilitators.

Several new studies have been published on strategies to reduce (inappropriate) allogeneic transfusions since the above mentioned reviews. We searched for 'reduction of inappropriate transfusions' using PubMed and selected 15 articles that were published in the period 2005-2017[27] In 7 studies the (de-)implementation strategies or interventions were chosen based on literature.[28-35] However, the other 8 out of 15 studies did not describe why the specific implementation strategy was chosen.[36-42] Of the selected 15 studies, only 3 described some type of problem analysis prior to the implementation to identify a target group or relevant barriers and facilitators.[28, 34, 37]

In comparison with this literature we attempted to improve the quality and thereby the effectiveness of our intervention by using a systematic approach with the 5-step model of

Grol.[1] The included problem analysis identified the relevant barriers (chapter 7). Barriers for de-implementation were identified on different domains relevant in behavioural change. Interventions tailored to the identified barriers that were deemed effective, based on literature, were chosen in the development of the de-implementation strategy (chapter 8). Implementation strategies tailored to previously identified determinants are frequently recommended to approach (de-)implementation, as behaviour change might be impeded by a variety of barriers. Nevertheless, the conclusion of the Cochrane review on tailored interventions to address determinants of practice by Baker et al[43] is that tailored implementation can be effective, but the effect is variable and tends to be small to moderate. A more recently published article by Wensing[44] raises concerns about tailoring as a recommended approach to implementation of innovations, due to the limited effects of tailored intervention strategies. In particular ongoing monitoring of factors during the delivery of the interventions seems required to adapt to contextual and political changes. Additionally it is not yet clear how best to select effective interventions tailored to address determinants, as there is limited insight into the linkages of determinants and interventions.[43,44] In this thesis we used the method described by Michie[4] to link interventions to previously identified barriers. However, here the linkage between determinants and interventions was based on expert opinion and was not substantiated with empirically evidence.

With this knowledge, the lack of effectiveness of our de-implementation strategy is not completely surprising, as the effect of tailored de-implementation strategies in general is found to be limited and highly variable. In executing the de-implementation strategy in chapter 9, we did (deliberately) not adapt the strategy during the execution, because adding new components to the strategy during the execution would have been a violation of our study protocol. Therefore, as is suggested by Wensing,[44] we might have missed out on developments influencing the uptake op cost-effective blood management.

Study design of de-implementation studies

In addition to this, in de-implementation research a control group is relatively often lacking. In Niven's review[5] the market withdrawal studies logically do not include a control group, in the other 4 intervention studies, 2 do not have a control group,[7,9] one study was a quasi-experimental study with interrupted time series[6] and only one was a controlled trial.[8] The reviews from Wilson and Tinmouth on the change of transfusion practice[25,26] included mainly before-after studies where no control group was included. In the more recent inappropriate transfusion studies 14 out of 15 lacked a control group.[29-42] The only study with a control group was a study protocol.[28] In this thesis the de-implementation strategy was tested in a cluster-randomized controlled trial. The results showed that in both the intervention group exposed to the de-implementation strategy and the control

group the use of EPO and blood salvage reduced (chapter 9). In other words, the de-implementation strategy was not more effective compared to the control strategy. This underlines the value of a control group, as in this study the lack of a control group would have resulted in the conclusion that the strategy was effective to reduce low-value blood management.

Methodological issues

Some limitations could be identified, which were related to the methodology. First, in our cluster randomized controlled trial (chapter 8), participants of both the intervention and control group hospitals were aware of their participation in a study, and they were aware of the study goal. We tried to avoid this during the inclusion of hospitals by involving a single person per hospital. However, contact persons wanted or needed to discuss participation in our trial with their colleagues. It is possible that the results, a decrease of blood salvage use and EPO use in both the intervention and control group, were influenced by the awareness of participants to be participating in a study. A different design, such as a stepped wedge model, could have prevented this bias. However, within a stepped wedge design the effect of the intervention might be confounded with any underlying temporal trends. Additionally, a more practical issue, with a stepped wedge design the study duration would have been doubled.

Secondly, the model of Grol used in this thesis was originally intended for implementation efforts. The use of an implementation model in de-implementation research may not have been the right choice, as different factors may be involved.[45] It is suggested that there are fundamental differences between implementation and de-implementation, as the perception of people regarding gains and losses is not symmetrical and it is harder to give up old (low-value) clinical practices that they have come to believe in, than to adopt new and promising innovations.[45-49] However, when starting the LISBOA de-implementation project, there were no de-implementation models available and we chose a model with a systematic approach to change behaviour. Other models for the implementation of behaviour change were available, such as the innovation process framework by Fleuren et al.,[50] a model that takes socio-political, organisational, personal characteristics and the characteristics of the topic and the change strategy into account in the implementation process; or the 'Knowledge to action process' by Graham et al.,[51] which describes a circular process on how available knowledge can be implemented. Meanwhile Niven et al. [5] suggested a model for the process of de-adoption largely similar to the implementation model of Graham. These models and the model of Grol that we have used resemble each other in their stepwise approach of implementation: assessment of the topic that needs implementation, a context analysis, selection and execution of a strategy for

implementation tailored to identified barriers and facilitators, and an evaluation of the results.

New developments and insights on de-implementation research have evolved during the research process of this thesis. For example in the article of Helfrich[52] medical overuse and its de-implementation is explained by the dual process model of cognition. In this model clinical decision-making is based on reflective cognition, a conscious process of evaluating option and automatic cognition, an unconscious process in response to environmental or emotive cues. De-implementation strategies may be conceptualized as corresponding to cognition: unlearning, based on reflective cognition; and substitution, based on automatic cognition. Unlearning may cause a reaction in clinicians with anger and negative cognition because they feel restricted in their decision-making. In substitution an alternative is promoted, in which the substitute replaces or displaces the low-value care. This model introduces the idea of substitution as a strategy to address overuse. This closely matches the findings in this thesis, where the de-implementation of low-value blood management techniques is accompanied by substituting the low-value techniques with a cheap and effective alternative, TXA, and by the increased use of LIA as local analgesic. Although it was not promoted in the de-implementation strategy, in both intervention and control groups the substitution was significantly associated with the reduction of low-value blood management techniques.

Implications for practice

In this thesis it was found that substitution of low-value care might contribute to de-implementation of this low-value care. In the development of de-implementation strategies this can be used to improve the results. Additionally, this thesis followed the stepwise model of Grol, including the identification of barriers to tailor the de-implementation strategy. The use of this model did not lead to the intended results in this thesis. More recent literature suggests that the tailoring of strategy components to the previously identified barriers may not be sufficient and continuous adaption to the factors and barriers might be needed. However, more factors may have played a role, such as awareness of participation in a study in the control arm of the cRCT or an overarching time trend of abandoning the selected blood management techniques. Therefore we cannot say whether the use of the Grol model should be stimulated or slowed down in further de-implementation efforts.

Recommendations for future research

This thesis gives insight into the process of de-implementation. However, the complicated matter of de-implementation research still needs to be further unravelled. More

knowledge on the determinants that hinder or facilitate de-implementation is needed. In particular knowledge is needed on how to tailor interventions to determinants (barriers or facilitators) and whether continuously adapting the interventions within a de-implementation strategy is of added value. Regarding future studies evaluating new de-implementation strategies we would like to emphasize the importance of a control group. In this thesis the lack of a control group would have led to reversed results. Instead of concluding that the de-implementation strategy was not effective in reducing low-value care compared to the control group, a great reduction in low-value care would have been observed in the intervention group.

Furthermore, we observed that de-implementation of a low-value technique is facilitated by the introduction of a substitute, a new or different technique, such as the use of TXA and LIA in this thesis. From literature it is known that, once established, it can be very difficult to discontinue low-value clinical practices.[5,46,48] As de-implementation of low-value care is essential to improve the quality of care for patients and reduce the ever increasing healthcare costs, it is very important to identify more relevant factors, such as substitution, that facilitate de-implementation. In addition to this, more knowledge is needed on the differences and similarities of implementation vs. de-implementation on the specific personal and contextual factors involved.[5,45] The development of systematic approaches or models for de-implementation would be very useful.

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