



Implementation Design of a Complex Nursing Intervention in Dutch Hospitals: A Methods Paper

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Abstract

Implementing complex nursing interventions can be challenging. The degree of fit between context and the intervention is essential in explaining whether the implementation succeeds or fails, how and to what extent the intervention achieves impact and whether interventions can be sustained or successfully translated from one context to another. We provide a comprehensive description of the design of the implementation of a complex nursing intervention, which is implemented in 12 cardiac surgery centres in the Netherlands. With this, we aim to enhance transparency and replicability about the method of the implementation and reflect on methodological choices. We follow general steps of implementation including (1) adapting evidence, (2) identifying barriers and facilitators, (3) tailoring implementation activities and (4) monitoring and evaluating. We chose a general predefined approach for support, measurements and feedback and combined this with a local tailored approach to enhance the fit between the intervention and its implementation context. For monitoring, we measured three implementation outcomes: barriers and facilitators, behaviours of involved professionals, which was guided by the COM-B model, and the fidelity of executing the intervention. Feedback based on the results of the measurements were returned to local project leaders to enhance the implementation strategy in each setting continuously. We made a clear distinction between implementation strategies at the general program level and the local project level. Through various measurements, in which behaviour change of professionals was central, feedback and mutual learning, we facilitated the implementation of a complex nursing intervention. We discuss methodological challenges about tailoring the implementation approach and providing feedback on the behaviour of professionals.

Keywords Implementation design · Complex intervention · Healthcare professionals · Behaviour change · Implementation feedback · Intervention fidelity

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Ageing populations are characterized by an increase in chronic diseases with subsequent increase in multifaceted and as such complex care delivery. Complex nursing interventions are developed to meet these increasingly complex patient needs. Complex interventions are characterized by multiple interacting components which are situated in an organizational and professional context (Craig et al., 2013). The more interacting components an intervention has, the more of a challenge it is to implement such an intervention (Greenhalgh, 2020).

Various definitions of implementation exist. Here, implementation is defined as ‘a planned process and systematic introduction of innovations and/or changes of proven value; with the aim that these are given a structural place in professional practice, in the functioning of organisations or in the healthcare structure’ (European Implementation Collaborative, 2020). As such, implementing an intervention

is done in a professional specific context. The degree of fit between context and the intervention is important in explaining whether the implementation succeeds or fails, how and to what extent the intervention achieves impact and whether interventions can be sustained or successfully translated from one context to another (Damschroder et al., 2009). Therefore, crucial aspects should be considered when implementing a complex intervention in a complex organizational and professional context. For example: adapt evidence to suit the local professional and organizational context; identify ‘barriers’ and ‘facilitators’ in this local context to knowledge use; select and tailor interventions; and monitor and evaluate the progress’. These tailoring activities need to be planned (Greenhalgh, 2017).

When implementing complex nursing interventions, several barriers have been described such as insufficient authority to change patient care procedures, perceived work and time pressures, high staff turnover, lack of continuous monitoring and control of the implementation, lack of motivation or inadequately developed interventions (Atkinson et al., 2008; Hutchinson & Johnston, 2004; Kormelinck et al., 2020; Parker et al., 2020; Rajabpoor et al., 2018; Smit et al., 2018). Facilitators are also described, such as early and sustained engagement of stakeholders, professional project manager, colleague and management support, integration with other activities, good planning and priority setting, availability of time, open and clear communication, motivation, adaptation to the needs of participants, positive impact on the clinical process and a positive impact on patient outcomes (Geerligs et al., 2018; Gravel et al., 2006; Hutchinson & Johnston, 2004; Kormelinck et al., 2020; Parker et al., 2020; Van Mierlo et al., 2018). Monitoring barriers and facilitators may enhance the further implementation of these interventions.

An example of a complex intervention to improve care for older cardiac surgery patients is the PREDOCS (PREventing Decline in Older Cardiac Surgery patients) consultation (Ettema et al., 2014). We know from earlier feasibility and effect studies on the PREDOCS consultation that the implementation requires adaptations in the work process of different professionals, with different responsibilities (Ettema et al., 2015). During an implementation process, modifications may be made to the content of interventions, as well as to the context in which interventions are delivered (Stirman et al., 2013). Nurses carry out the intervention, but besides the patient, other professionals are involved, such as a secretary or a planner, the nurse manager and the medical doctor. Different professionals work together each completing a different task which jointly contributes to the successful performance of the consultation. A previous feasibility study found that possible barriers and facilitators for further implementation of the PREDOCS consultation were related to changing professionals’ behaviour (Ettema et al., 2015).

To understand professionals’ behaviour in relation to the delivery of a complex intervention, a universally applicable model like COM-B model can be used (Michie et al., 2014).

In this paper, we provide a comprehensive description of the design of the implementation of the PREDOCS consultation, guided by the COM-B model, that was implemented in 12 cardiac surgery centres in the Netherlands. Our purpose is to enhance transparency and replicability of the methods of implementation of a complex nursing intervention and to reflect on methodological choices. We describe the method and protocol for implementation. Results will be published in a separate paper.

Methods

The PREDOCS consultation was implemented from 2016 until 2019 in seven top clinical hospitals and five university hospitals geographically spread across the Netherlands. We opted for an implementation strategy with a generic implementation approach at the general program level, facilitating a dynamic, tailor-made approach on the project level in each hospital (Fig. 1). As such, in each setting ($n = 12$), the implementation approach is carefully designed and planned. In this approach, feedback based on measurements played a central role.

The generic implementation approach consisted of four steps: first, we adapted evidence to suit the different local contexts; second, we identified local barriers and facilitators to knowledge use; third, we selected and tailored the implementation activities to the local settings; and fourth, we monitored and evaluated the progress during the implementation (Damschroder, 2020; Greenhalgh, 2017; Grol & Grimshaw, 2003). As every participating hospital has specific contextual factors with different barriers and facilitators, this generic approach resulted in implementation strategies tailored to each centre (Craig et al., 2018; Greenhalgh, 2017).

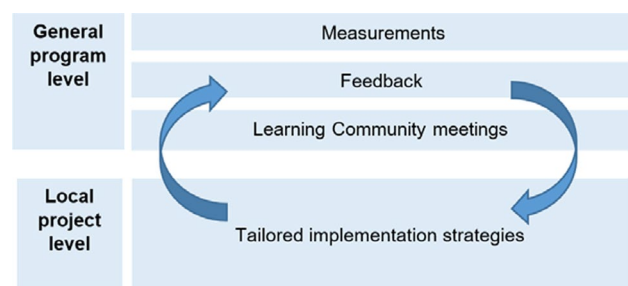


Fig. 1 Implementation strategy

The PREDOCS Consultation

The PREDOCS consultation is an effective evidence-based multicomponent nursing intervention. It aims to improve older patients' physical and psychosocial conditions to reduce their risk of postoperative complications on delirium, depression, pressure ulcers and infection (Ettema et al., 2015). The fidelity study of Ettema and colleagues (2015) shows that both patients and nurses were satisfied with the tools for guiding patients to reduce their risk of postoperative complications and considered the PREDOCS consultation as complementary to usual care. The PREDOCS consultation will be cost-effective when postoperative complications are prevented in 6 to 16 of 1000 cardiac surgery patients who received the consultation.

The intervention is administered during a consultation by a trained 'PREDOCS nurse' 2 to 4 weeks before surgery. It consists of one consultation, which takes place in the hospital. The consultation includes three parts: a general part for all patients, a second part in which patients with an increased risk for care-related postoperative complications are identified and a third part in which selected patients are informed about how to prepare themselves for the hospital admission to reduce their risk, see Online Resource 1: Composition of the PREDOCS consultation (Ettema et al., 2014).

The consultation is based on three guiding principles:

- **Timing:** The vast majority of patients with an indication for cardiac surgery is medically stable with a subsequent waiting time for the hospital admission. With the PREDOCS consultation, conducted at the start of this waiting time, i.e. the moment of the decision for cardiac surgery, this time is now considered 'preparation time'. In this time, the patient with the family can reduce the increased risk of postoperative care-related complications. The PREDOCS consultation usually takes place about 5 to 2 weeks before surgery.
- **Risk assessment aimed at selecting vulnerable patients:** At the start of this waiting time, a risk assessment provides insight for each patient into a potential increased risk of postoperative complications. Patients are screened for an increased risk to develop delirium, depression, pressure ulcers or an infection during the hospital admission after surgery. In case of increased risk, personalized preventive measures can be taken in the preadmission period.
- **Self-management support:** Both at risk and non-at risk patients are supported in self-management. For this, information is provided at three levels: (1) the procedure in the hospital itself, (2) information about what the patient can expect and (3) what the patient can and should do to reduce the risk of a postoperative compli-

cation. The nurse will discuss personalized preventive measures with the patients with an increased risk and their accompanying family, friend or neighbour. These preventive measures enable them to reduce their risk before admission to the hospital.

To ensure continuity of care, the findings of this consultation are reported to the nursing team that is in charge during the patient's hospital admission.

Project Structure for Implementing the PREDOCS Consultation

In preparation for implementation, a project structure was set up focussing on the general program level approaching all hospitals and a focus on the local project level in each specific hospital. At the general program level, two project leaders (YJ, RE) were the point of contact for all 12 participating hospitals. They coordinated the project, provided support in developing the local implementation strategy and continuously supported improving the implementation strategy in each hospital. At the local project level, each participating hospital had its own project leader responsible for implementing the PREDOCS consultation and was supported by a dedicated team.

Implementation Strategy

Interventions, such as the PREDOCS consultation, can be divided into essential elements of the intervention itself and adaptable elements related to the intervention and organization where it is to be implemented. Adaptable elements allow the intervention to be tailored to the setting without undermining the integrity of the intervention (Damschroder et al., 2009). The guiding principles 'Timing', 'Risk assessment' and 'Self-management support' are considered the essential elements of the PREDOCS consultation. We adequately described these guiding principles at the general program level and focussed on their implementation, enabling hospitals to get those guiding principles into operation, adapted to their context.

During the implementation of the PREDOCS consultation, we used implementation strategies at the local project level and at the general project level. In Table 1, we describe general implementation strategies and in Table 2, we provide three examples of local implementation strategies.

Implementation Strategies at the Local Project Level

In each hospital a project leader was assigned, which started with a proposal for implementation from which the involved team implemented the working mechanisms of the PREDOCS consultation in their own work process. For this,

Table 1 Implementation strategy

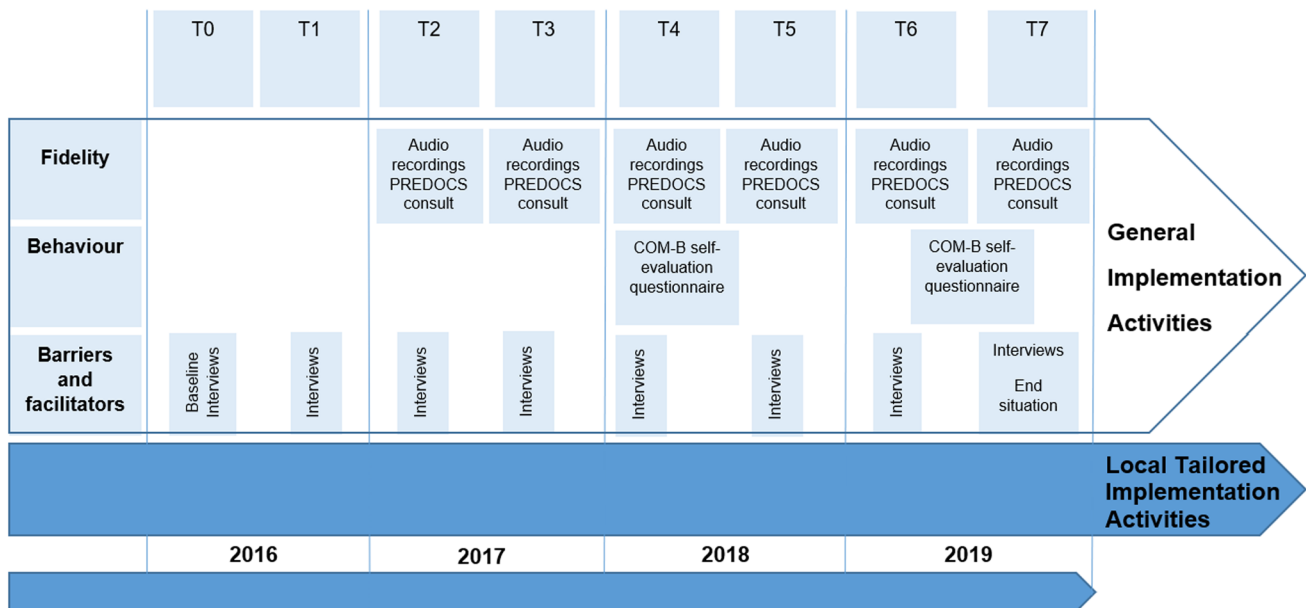
Implementation strategy	Measure the progression of implementation	Give feedback based on measurements	Organize national learning community meetings
Actor(s)	General project leaders	General project leaders	Local and general project leaders
Action(s)	<p>Measure:</p> <ul style="list-style-type: none"> - Barriers/facilitators in interviews - Behaviour change (COM-B self-evaluation questionnaire) - Fidelity (audio recordings PREDOCS consultation) 	<p>Give feedback focussed on barriers and facilitators of implementing the intervention, behaviour change of healthcare professionals and fidelity</p>	<p>Mutual learning, share experiences and evaluating implementation progress</p>
Target(s) of the action	<p>Local project leaders, PREDOCS nurses, ward nurses, managers, surgeons, data managers and planners</p> <p>Knowledge about local implementation barriers and facilitators, behaviour of healthcare professionals and fidelity to improve local implementation strategies</p>	<p>Team of clinicians who are implementing the intervention, in particular project leaders and PREDOCS nurses</p> <p>Feedback given by the project leaders at the general program level to professionals on the local level and vice versa, creating a continuous feedback loop</p>	<p>Local project leaders and local project members</p> <p>Facilitate the development of local implementation strategies</p>
Temporality	Continuous process during implementation	Continuous process during implementation. After analysis of measurements	Started in the preparatory phase of implementation and continued during implementation
Dose	During four years, every half-year	During four years, every half-year	During four years, every half-year
Implementation outcome(s) affected	<p>Appropriateness, feasibility and sustainability (barriers and facilitators of implementation), acceptability and adoption (COM-B self-evaluation questionnaire), fidelity of the execution of the intervention, by comparing the audio-recorded deliverance with the protocol (delivered as intended)</p>	<p>Appropriateness (perceived fit of the intervention), feasibility (suitability for every day practice), sustainability (integration, sustained use), acceptability (comfort with the intervention), adoption (intention to try), fidelity (adherence to the protocol, delivered as intended)</p>	<p>Adoption (uptake in each centre), appropriateness (practicability in each centre)</p>
Justification	<p>Identify barriers and facilitators (Damschroder et al., 2009; Greenhalgh, 2017; Grol & Grimshaw, 2003)</p> <p>Implementing new practices requires changes in the behaviour of relevant actors, facilitated by understanding determinants of current and desired behaviours (Atkins et al., 2017)</p> <p>Measure to what extent the guiding principles were achieved (Breitenstein et al., 2010; Carroll et al., 2007)</p>	<p>We provide feedback at predetermined moments, enabling project leaders to adjust their implementation strategy. This contributes to implementation success since it supports the transition from current to the desired behaviour (Michie et al., 2014)</p>	<p>Provide a forum for each staff to share experiences, to learn, to exchange knowledge and discuss with peers (Geerligs et al., 2018)</p>

Implementation strategies follow the domains outlined by Proctor et al., 2013

Table 2 Three examples of a local implementation strategy

Implementation strategy	Training PREDOCS nurses	Identification of postoperative complications	Case review
Actor(s)	General project leader, expert/ developer of the PREDOCS consultation	Local project leader, data manager	Local project leader, nurses who provide the PREDOCS consultation
Action(s)	Provides training to every PREDOCS nurse	Returning the incidence of postoperative complications to nurses on the ward through a presentation during a team meeting	Discuss postoperative course of one patient who followed the PREDOCS consultation, the use of preventive nursing interventions and postoperative complications
Target(s) of the action	Nurses who will provide the PREDOCS consultation	Nurses providing postoperative care to cardiac surgery patients Creating awareness of the incidence of postoperative complications and the need for prevention of these complications in relation to nursing interventions	Nurses providing postoperative care to cardiac surgery patients
Temporality	Training will be given before nurses start executing the PREDOCS consultation	Continuous process during implementation	When the PREDOCS consultation is implemented
Dose	One training, 4 h	Twice a year	Twice a year, during a team meeting
Implementation outcome(s) affected	Acceptability (comfortable with the intervention), fidelity (adherence to the protocol)	Adoption, appropriateness (relevance for daily practice)	Adoption and fidelity, feasibility for everyday use
Justification	Educate and train cognitive, physical or social skills (Michie et al., 2014; Smit et al., 2018)	Improve knowledge, creating awareness (Michie et al., 2014)	Knowledge, creating awareness, modelling (Michie et al., 2014)

Implementation strategies follow the domains outlined by Proctor et al., 2013



Between T0 and T7 data regarding fidelity, behaviour and barriers and facilitators were collected by audio recordings, COM-B self-evaluation questionnaires and interviews. These activities were part of the general implementation strategy. The results were important input to tailor the local implementation strategy. Furthermore, patient outcomes on postoperative delirium, depression, pressure ulcer and infection were collected twice a year in 2016 until 2019

Fig. 2 Measurements and feedback during implementation process

all nurses who executed the PREDOCS consultation were trained by RE in a 4-h workshop at the start of the implementation in each hospital. During the implementation process, there was the possibility of retraining, for example, during personnel changes. Project leaders at the local project level developed the implementation strategy based on the specific features of their context. For example, they checked whether the PREDOCS consultation was in line with existing processes, knowledge and skills of involved professionals, staff availability, or the ability to implement the PREDOCS consultation on a small scale first. An example of this small-scale approach was starting PREDOCS consultations with patients from their own hospital rather than patients from a referring hospital. Besides context factors, project leaders at the local level also identified barriers and facilitators for implementation and steered the focus of the implementation strategy. The general program leaders supported the local project teams with a training for the nurses who performed the PREDOCS consultation, helped writing a local implementation plan and monitoring the implementation by YJ and RE. In Table 2, we provide an overview of three local implementation strategies.

Implementation Strategies at the General Project Level

To support each project team in each local setting to put the guiding principles of the PREDOCS consultation into

operation, at the general program level, we measured the progression of implementation, gave feedback and organised national learning community meetings (Fig. 1 and Table 1). At the general program level, we measured barriers, facilitators, behaviour change of professionals and fidelity. To accurately monitor the implementation strategy on local level, the use of feedback was essential and therefore a structural part of the implementation strategy. The feedback focussed on barriers and facilitators, behaviour, and fidelity and was given by the project leaders at the general program level to professionals on the local level and vice versa, creating a continuous feedback loop. As an ultimate endpoint of the implementation of the nursing intervention, the prevalence of postoperative delirium, depression, pressure ulcer and infection were followed in each hospital (Fig. 2). To facilitate the development of local implementation strategies, learning community meetings were organised.

Measurements

At the general program level, measurements were an essential part of the implementation approach.

Barriers and Facilitators

To understand changes in the organizational and professional context, experienced barriers and facilitators were

measured (Damschroder et al., 2009; Grol & Grimshaw, 2003). Half-yearly semi-structured interviews with all involved healthcare professionals such as PREDOCS project leaders, PREDOCS nurses, managers, general ward nurses, cardiothoracic surgeons, planners and data managers in the 12 cardiac surgery centres were conducted. Those interviews provide insights in whether the consultation can or was implemented according to the guiding principles; if the consultation is or can be applied in the same way for each patient; and what the barriers and facilitators are in conducting the consultation.

Behaviour

Previous research showed that most barriers and facilitators for implementing the PREDOCS consultation are related to changing professionals' behaviour (Ettema et al., 2015). Therefore, we chose to use the Behaviour Change Wheel and its COM-B model as the framework for tailoring implementation strategies to the local barriers and facilitators (Michie et al., 2014). To understand the subsequent barriers and facilitators in changing the behaviour of the involved professionals, we systematically questioned current professional behaviour in terms of capabilities, opportunities and motivations: COM-B model (Michie et al., 2014). According to this model, capability, opportunity and motivation (COM) jointly lead to behaviour (B). These three aspects affect the process of coming from current to desired behaviour:

1. **Capability:** the professional must have the knowledge, skills, psychological strength and stamina to organize, provide and enable the nursing intervention in the desired way.
2. **Opportunity:** to organize, enable and provide the nursing intervention, e.g. what the environment facilitates in terms of time, triggers, resources, locations, personnel and integration in the hospital information system and the feeling of a shared responsibility regarding one's tasks in the nursing intervention.
3. **Motivation:** professionals must be motivated to organize, provide and enable the nursing intervention at the appropriate time.

Capability, opportunity and motivation of all involved professionals were measured through the adapted 'COM-B Self-Evaluation Questionnaire', specified for PREDOCS (COM-B-QP). It concerns a self-evaluation questionnaire, filled in by all healthcare professionals involved at two moments during the implementation to measure the necessary change of behaviour of all involved professionals. The COM-B-QP varies between 14 and 26 items and was developed for each group of professionals, adapted to the context

of each centre, measuring the extent to which they agreed with the items on a 7-point Likert scale (1 = 'strongly disagree'; 7 = 'strongly agree'). Concerning capability, we measured aspects of knowledge, skills and psychological strength. Concerning opportunity, we measured physical accessibility as well as social acceptability. Physical accessibility involves what the environment allows or facilitates in terms of time, triggers, resources, locations, personnel and integration in the hospital information system (Michie et al., 2014). We also measured the social acceptability, which concerns the feeling of shared responsibility regarding one's tasks in the PREDOCS consultation (Michie et al., 2014). Concerning motivation, we measured reflective motivation, involving self-conscious planning and evaluations, beliefs about what is good and bad, and automatic motivation involving emotional reactions, desired, impulses or reflex responses (Michie et al., 2014). For details, see Online Resource 2: Composition of the questionnaire with COM-B questions by function. The results of this questionnaire were returned to project leaders to enable them to achieve the desired behaviour of the professionals involved in organising, providing and enabling the PREDOCS consultation.

Fidelity

Complex interventions need to be tailored to each individual patient and consequently effective deliverance can be challenging. Therefore, we measured the fidelity of the delivery of the consultation according to the guiding principles (see above and Online Resource 1: Composition of the PREDOCS consultation). To determine the degree to which the intervention was delivered as intended and acts as a potential moderator of the relationship between interventions and their intended outcomes, we measured whether the intervention was implemented in such a way that the guiding principles were achieved (Carroll et al., 2007). As such, this fidelity is a critical component in the implementation of evidence-based practice (Breitenstein et al., 2010). For measuring this intervention fidelity, every half-year, PREDOCS nurses made audio recordings of the PREDOCS consultation.

The local project leader in every hospital was asked to collect audio recordings from PREDOCS nurses. This resulted in a convenience sample of PREDOCS consultation recordings per hospital, in which PREDOCS nurses alternately provide audio recordings. The audio recordings were made every 6 months, which provided an impression of the fidelity of delivery of PREDOCS and provided feedback for all PREDOCS nurses. Overall, each hospital had approximately 4–6 PREDOCS nurses. Every 6 months, the national project leader received 0–4 audio recordings per hospital, depending on phase of implementation. From 2017

until 2019, a total of 85 audio recordings were made, spread over 11 hospitals, varying between 2 and 21 per hospital.

Furthermore, there was a continuous registration of postoperative complications in patients, which was used as a feedback indicator for nurses and other professionals in every ward. This indicator aims to raise awareness among all professionals involved and provides information about a possible trend in postoperative complications.

Feedback on Implementation and Fidelity

For professionals working in a professional and organizational context who are implementing a complex intervention, it is crucial to get insight into the barriers and possible solutions for problems for each local project team on regular basis. Feedback information supports revealing barriers and accommodates insight in possible solutions. As such, feedback from national project leaders is a crucial implementation activity. Feedback based on the results of the interviews, the audio recordings and the questionnaires were returned to local project leaders to continuously enhance the implementation strategy in each setting (Fig. 1). For enabling them to improve their implementation strategy, the project leader in each hospital received feedback based on their own results.

Barriers and Facilitators

Every 6 months (T0–T7) last year bachelor nursing students conducted face-to-face semi-structured interviews with professionals in the hospitals to explore perceived barriers and facilitators. The local project leader received a report with the analysis and results of the interviews, enabling them to improve the implementation strategy.

Behaviour

The COM-B-QP questionnaire is administered twice (year 3 and year 4) to all professionals involved in all cardiac surgery centres. Participating hospitals received the analysis in which their own hospital score is compared to the average of all centres, on all facets of the COM-B model. Based on this analysis and with support and feedback from the national project leaders, hospitals were able to improve the implementation strategy with interventions from the Behaviour Change Wheel.

Fidelity

The degree to which the PREDOCS consultation was delivered as intended by nurses was measured by audio recording of the PREDOCS consultations delivered to older people (≥ 65 years) who would undergo cardiac surgery in each of the 12 cardiac surgery centres. Every half-year PREDOCS

nurses made audio recordings of consultations (T2–T7). PREDOCS nurses received feedback on the PREDOCS consultation by the national project leader (YJ). Based on this feedback on performance, they were able to improve conversation techniques and their implementation strategy.

Fidelity was assessed based on the guiding principles of the PREDOCS consultation, see Online Resource 1: Composition of the PREDOCS consultation. All audio recordings were transcribed and in a qualitative analysis the content of the audio recordings was compared with the written evidence about working mechanisms of the PREDOCS consult. Deviations from the working mechanisms delivered content for feedback which was each time provided by the general project leader (YJ) to the local project leaders. Subsequently, each nurse received the transcript including feedback and had the opportunity to discuss this with the general project leader by telephone or physical appointment.

National Learning Community Meetings

Each half-year, joint learning community meetings took place, in which local project leaders and local project members learned from and with each other, shared experiences and showed their progress. During the meetings, each participating hospital presented a dashboard with measures concerning the implementation progress. The dashboard includes the local aim for implementation, the patients involved, the departments involved, the implementation period, the progress of the implementation plan, the moment the kick-off meeting is held, the start of the null measurement, the start of executing the PREDOCS consultation, evaluation and feedback of results, experienced implementation bottlenecks, possible effective measures taken and experienced enabling factors. Local project leaders had the opportunity to adjust their implementation strategy based on feedback on the implementation barriers and learned about enabling factors of other participating centres.

Discussion

To enhance the body of knowledge of implementing complex nursing interventions, we described the design of the implementation of a multicomponent nursing intervention, ‘the PREDOCS consultation’, in 12 cardiac surgery centres in the Netherlands to enhance transparency and replicability. In implementing this consultation, we follow general steps of implementation including (1) adapting evidence, (2) identifying barriers and facilitators, (3) tailoring implementation activities and (4) monitoring and evaluating. We used a predefined approach at the general program level combined with a dynamic tailored approach at the hospital level. For monitoring, we measured three implementation

outcomes: barriers and facilitators, behaviours of involved professionals and the fidelity of executing the intervention. There are some potential issues and limitations regarding our implementation approach that need to be discussed and we reflect on the methodological choices made in relation to its potential success.

Tailoring of the Implementation Approach

We chose a general predefined approach for support, measurements and feedback and combined this with a local tailored approach to enhance the fit between the intervention and its implementation context (Damschroder et al., 2009; May et al., 2009). Local project leaders developed their own implementation strategy based on the specific features of their context. A consequence of this approach is that the main responsibility for implementation lies with local project leaders. The degree of implementation depends on the competencies of local project leaders (Van Mierlo et al., 2018), e.g. whether they focus on the leading principles of the PREDOCS consultation or the specific barriers and facilitators in their setting. At the general program level, we tried to minimize this risk by providing feedback on local project plans at the start of the implementation and by feedback based on analyses of barriers, facilitators, behaviour (COM-B-QP) and audio recordings. Furthermore, project leaders met regularly to learn from each other in learning community meetings.

Another aspect of tailoring the implementation is that it enforced mutual learning among the 12 involved centres, in which the process of implementation is different. In addition, we expected that context-specific factors and implementation progress vary among the sites. These differences allow mutual learning. However, differences might also be a barrier for mutual learning, in case the differences in context or culture are significant and prevent recognition. To support mutual learning and bridging significant differences, we organized semiannual learning community meetings where all local project leaders, local project team members and PREDOCS nurses were invited. Strategies at the general program level, such as integration of ongoing feedback and regular contact to continually address concerns, provide a forum for each staff to share experiences (Geerligs et al., 2018). These actions can contribute to the implementation success in each local setting, since a one-size-fits-all approach does not acknowledge the different features of the sites that threaten the fit between context and intervention (Damschroder et al., 2009; Greenhalgh, 2017).

Feedback on Behaviour

An essential element in implementing a complex intervention such as the PREDOCS consultation is changing

the behaviour of different professionals involved such as planners, PREDOCS nurses and managers. In our study, we chose to provide regular feedback on the behaviour of professionals. We did this by measuring (1) the capability, opportunity and motivation of all different involved professionals and (2) measured fidelity of the PREDOCS consultations delivered by PREDOCS nurses. We provide feedback at predetermined moments, enabling project leaders to adjust their implementation strategy, which may contribute to implementation success since it supports the transition from current to desired behaviour (Michie et al., 2014). On the general program level, it enables comparison between hospitals. However, a limitation is that the needed time for analysis of measurements of capability, opportunity and motivation of all different involved professionals and fidelity of the PREDOCS consultations might introduce a time gap that lowers the impact of the feedback. A possible risk is that feedback provided retrospectively may hinder the professionals involved in immediately adjusting their actions in clinical practice.

COM-B

We used the COM-B model and the self-evaluation questionnaire to support professionals in adapting new desired behaviour. The original COM-B questionnaires (Michie et al., 2014) are intended to indicate of how the components of COM-B could be explored. We adapted the COM-B self-evaluation questionnaire to the COM-B-QP to measure the behaviour of different involved professionals in our specific context. Most respondents viewed the questionnaires as a method to improve and support implementation. Therefore, we believe that socially desirable responses in the self-reports were not very likely. In contrast to the high frequency of data collection with interviews and audio recordings, the COM-B-QP was only measured twice since it is labour-intensive due to the many items. Furthermore, the adapted questionnaire was not validated. Despite these limitations, the advantage is that we have a comprehensive overview of behaviour.

Fidelity

In terms of measuring the fidelity (Bellg et al., 2004), we examined to what extent the guiding principles of the PREDOCS consultation were followed, which provide insight into the actual degree of implementation success. We measured fidelity with audio recordings and gave feedback on how the guiding principles were implemented. However, these audio recordings had to be analysed before feedback could be given. A challenge was that the feedback was not provided immediately after delivering the consultation. Nurses provided an average of two audio recordings every 6

months of PREDOCS consultations per hospital to monitor the fidelity. It can be questioned whether this will provide enough detailed information to report the fidelity of the intervention delivery. However, it does give an understanding of what happens during the delivery of the consultations. A weakness of using only self-recorded audio sessions to measure fidelity could be that nurses select only 'good' PREDOCS consultation. Moreover, we only analysed a few PREDOCS consultations, which may not give a complete picture. Adding observations as additional data collection would make it stronger, but was not possible given the large number of participating hospitals.

Another limitation of using self-recorded audio sessions is that nurses who are uncertain may not make an audio recording which could result in bias. Although the national project leaders may have only seen the better consultations, room for improvement was still identified in those consultations. This feedback provided input for the entire team, including the nurses who were less confident recording consultations. As such, the less good consultation could be improved by the feedback given to the whole team.

A strong element is that much effort is put into the training of the professionals before implementation to enhance fidelity. Training professionals is an essential step before performing a complex intervention in clinical practice. To achieve high fidelity, training is given at the local level before the implementation (Smit et al., 2018).

Reflecting on our implementation choices, a few additional points must be considered. In the Netherlands, there are 16 cardiac surgery centres and only 12 of them join this project. Four centres did not participate for reasons such as reorganization and conflicting with a large ongoing trial. These centres reflect the characterization of the other 12 involved and therefore we think we have sufficiently different contexts involved in our study. Finally, the participating hospitals received funding to cover the costs of starting the PREDOCS consultations. Implementation is aimed at continuation of the PREDOCS consultation without funding, with the view that the participating hospitals embed the PREDOCS consultation in the hospital structure. At the general program level, we contribute to this by educating professionals, influencing employee behaviour, motivating them to adapt processes and focus on sustainability.

Conclusion

In conclusion, for implementing a multicomponent nursing intervention we chose a general predefined implementation structure with a dynamic adaptive approach at local project level, following four general steps of implementation. Our subsequent implementation approach consisted of (1) measurements on barriers and facilitators, behaviours of involved

professionals and the fidelity of executing the intervention, (2) continuously feedback on different levels based on the measurements and (3) national meetings for mutual learning. The project structure (general/local) provides a fit between the intervention and the context. The included measurements and feedback loops contribute to an optimal implementation strategy at local level. In comprehensively describing the design of implementing a complex intervention in different hospital settings and addressing the challenges and subsequent solutions, we contribute to the body of knowledge of implementing complex nursing interventions.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Ethical Approval The Medical Ethics Research Committee of the Isala hospital in Zwolle in The Netherlands confirmed that no ethical approval was required.

Code Availability Not applicable.

Consent to Participate All 12 cardiac surgery centres have consented to participate in this study. They are verbally and in writing informed about the contents and have given written consent by signing a contract.

Consent for Publication Not applicable.

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