Components of professional behaviour related to the implementation of the PREDOCS programme in cardiac surgery centres in the Netherlands: an analysis informed by the COM-B model

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ABSTRACT

Title: Components of professional behaviour related to the implementation of the PREDOCS programme in cardiac surgery centres in the Netherlands: an analysis informed by the COM-B model.

Background: Implementation of complex interventions depends on behaviour change of healthcare professionals, which requires a good understanding of current behaviour. The COM-B model provides a systematic method to analyse behaviour, assuming that behaviour(B) is part of an interacting system involving Capability(C), Opportunity(O) and Motivation(M). The PREDOCS programme, a nursing intervention to reduce the risk for postoperative complications in cardiosurgical patients, gets currently implemented in cardiac surgery centres. In order to advance the implementation process, insight in the current behaviour of involved professionals is essential.

Aim: The purpose of this study is to identify the capabilities, opportunities and motivations, related to current professional behaviour of professionals involved in enabling and providing the PREDOCS programme in cardiac surgery centres in the Netherlands.

Methods: This study has a descriptive, observational design with a quantitative cross-sectional data collection. The source population consists of all professionals involved in the implementation of PREDOCS. The capabilities, opportunities and motivations of these professionals are measured through items rated on a 7-point Likert scale using the COM-B-QP, a questionnaire specified to PREDOCS. Data was stratified by hospital and by role.

Results: This study had a response rate of 67.3%. In general, social and physical opportunity were scored lowest by all roles except surgeons. Every PREDOCS role reported a median score o 6.0 or higher for capability. Motivation subcomponents scores were reported lowest by ward nurses and surgeons.

Conclusion and recommendations: Social and physical opportunity were identified as most important components to target. However, inter-hospitality differences have to be taken into account. This study forms a starting point in order to advance the implementation process of PREDOCS.

Key words: Behaviour change – Implementation science – Behaviour analysis – COM-B model – PREDOCS programme

SAMENVATTING

Titel: Professionele gedragscomponenten gerelateerd aan de implementatie van het PREDCOS-programma in cardio-chirurgische centra in Nederland: een analyse door middel van het COM-B-model.

Achtergrond: Implementatie van complexe interventies is afhankelijk van gedragsverandering bij zorgprofessionals, wat een goed begrip van de context en huidige gedrag vereist. Het COM-B-model voorziet een systematische methode om gedrag te analyseren, ervan uitgaande dat gedrag (B) onderdeel is van een interactief systeem van 'bekwaamheid' (C), 'mogelijkheid' (O) en 'motivatie' (M). Het PREDOCS-programma, een verpleegkundige interventie om het risico op postoperatieve complicaties bij cardio-chirurgische patiënten te voorkomen, wordt momenteel geïmplementeerd in cardio-chirurgische centra. Om het implementatieproces te verbeteren, is inzicht in het huidige gedrag van iedere betrokken zorgprofessional essentieel.

Doel: Het doel van deze studie is om de bekwaamheden, mogelijkheden en motivaties te identificeren die gerelateerd zijn aan het gedrag van professionals die betrokken zijn bij het organiseren en uitvoeren van het PREDOCS-programma in cardio-chirurgische centra in Nederland.

Methode: Deze studie heeft een beschrijvend, observationeel design met een kwantitatieve datacollectie. De populatie bestaat uit alle zorgprofessionals die betrokken zijn in het implementatieproces van PREDOCS. De gedragscomponenten zijn door middel van de COM-B-QP, een op PREDOCS gespecificeerde enquête gemeten waarin items zijn uitgedrukt op een 7-punts Likert schaal. Data is gestratificeerd per ziekenhuis, per rol en een combinatie hiervan.

Resultaten: Deze studie heeft een respons van 67.3%. Over het algemeen zijn de componenten van 'mogelijkheid' het laagst gescoord bij alle PREDOCS rollen behalve bij chirurgen. Alle PREDOCS-rollen hebben een 6.0 of hoger gescoord op 'bekwaamheid'. 'Motivatie' scores waren het laagst gerapporteerd door afdelingsverpleegkundigen en chirurgen.

Conclusie: De gedragscomponenten 'sociaal en fysieke mogelijkheid' zijn geïdentificeerd als meest belangrijke componenten om op te richten. Anderzijds dient er rekening gehouden te worden met verschillen tussen ziekenhuizen. Dit onderzoek vormt een beginpunt voor het verbeteren van het implementatieproces van PREDOCS.

Trefwoorden: Gedragsverandering – Implementatieonderzoek – Gedragsanalyse – COM-B-model – PREDOCS-programma

INTRODUCTION

Studies conducted in the USA and the Netherlands show that about 30-55% of patients do not receive care according to present scientific evidence.[1,2] The main reason for the lack of translation of research findings into practice is an absent or non-effective implementation process.[3–5] Improving the implementation of evidence based practice depends on behaviour change and requires appropriate implementation strategies and specific behaviour change techniques (BCTs).[6–10]

Systematic reviews of implementation trials show inconsistent findings and variation in the effect sizes of strategies used to influence behaviour.[6,11,12] Reasons for this are an insufficient understanding of the setting, wrong assumptions about contextual characteristics and an inadequate analysis of professionals' barriers and facilitators to change their behaviour.[11,13,14] A scientific assessment of what needs to change, in the context in which it occurs, is therefore an essential step in developing effective BCTs.[6–10,15–17] Especially in case of complex interventions the effectiveness is critically influenced by the success of their implementation, since these multicomponent interventions target different groups and are more sensitive to features in local contexts.[9,10,18]

The complex nursing intervention called 'PREvention of Decline in Older Cardiac Surgery patients' (PREDOCS programme) is currently being implemented in 12 cardiac surgery centres in the Netherlands. The PREDOCS programme consists of a structured consultation by a nurse, two to four weeks before hospital admission. Within this consultation, vulnerable older patients are identified and supported to reduce their increased risk for frequently occurring postoperative complications, like pressure ulcers, delirium and depression.[19]

The implementation requires adaptations in the work process of different healthcare professionals, with different responsibilities. In this regard, seven different roles are identified within the organising, enabling and providing of the PREDOCS programme: project leaders, PREDOCS nurses, ward nurses, managers, planners, cardiothoracic surgeons and data managers. In order to find appropriate BCTs and to advance the implementation process of the PREDOCS programme, it is essential to obtain insight in the current behaviour of all involved healthcare professionals first.[20]

There are many overlapping and complex methods to understand behaviour and to link this understanding to appropriate BCTs. The Behaviour Change Wheel (BCW) is a widely used comprehensive, systematic method, a synthesis of 19 frameworks of behaviour change found in a systematic literature review by Michie et al.[21] The COM-B model, the starting point used by BCW, is a method to theoretically analyse components of current behaviour and makes a diagnosis of what needs to shift to achieve a desired change in behaviour.[7,13,21,22] It

assumes that every individual to engage in particular desired Behaviour (B) requires Capability (C), Opportunity (O) and Motivation (M), three components that interact with each other (Figure 1).[13,22,23] The COM-B model has been used successfully in BCT development processes across different contexts,[20,22–25] and provides an appropriate diagnostic analysis method to better understand the underlying behavioural mechanisms of different healthcare professionals involved in organising, enabling and providing the PREDOCS programme in cardiac surgery centres in the Netherlands.

(Figure 1)

OBJECTIVES

The purpose of this study was to identify the capabilities, opportunities and motivations of the current behaviour of professionals involved in organising, enabling and providing the PREDOCS programme related to the desired capabilities, opportunities and motivations of the accompanied desired behaviour of these professionals in cardiac surgery centres in the Netherlands.

METHODS

Study design

This study had a descriptive, observational design with a quantitative cross-sectional data collection method. A descriptive cross-sectional study design is chosen since we aimed to obtain insight in the current behaviour of professionals at a one-time point in the implementation process and were not looking for explanatory results.

This study was embedded within the implementation study of the PREDOCS programme, which had started in January 2016 in twelve cardiac surgery centres in the Netherlands.

Population

The source population of this study consisted of all professionals from the twelve cardiac surgery centres who fulfilled at least one role in organising, enabling and/or providing the PREDOCS programme. Prior to this study, seven ‘PREDOCS roles’ were identified: PREDOCS project leaders, PREDOCS nurses, managers, general ward nurses, cardiothoracic surgeons, planners and data managers. We assumed that the PREDOCS roles could be represented by different types of professionals across the subjected cardiac

surgery centres. An overview of the roles, their corresponding tasks and possible representing professionals, is presented in Table 1. Furthermore, it was taken into account that every PREDOCS role was represented by at least one professional in every cardiac surgery centre and secondly, that one professional could be responsible for the fulfilment of multiple PREDOCS roles.

(Table 1)

The involved cardiac surgery centres had started with the implementation of the PREDOCS programme in 2016 and 2017. Some of them were still in the preparatory phase, while others started with performing PREDOCS consultations in the first months of 2017. A list of the concerned cardiac surgery centres is presented in Table 2. Five of them were university hospitals, the other seven were 'top clinical hospitals' ("STZ"). The cardiac surgery centres were spread across all over the Netherlands; some were located in rural areas, others in urban or metropolitan areas.

(Table 2)

Sample size

In this study, different sampling methods were used to reach a representative sample of every PREDOCS role. For PREDOCS nurses and project leaders, total population sampling was used. Project leaders and PREDOCS nurses are of high importance in the implementation process of intervention as they have a relatively big contribution in organising, providing and enabling the PREDOCS programme. Project leaders are responsible for the coordination of the implementation process in their hospital and PREDOCS nurses execute the most important part of the programme as they provide the PREDOCS consultation. To reach a reliable and complete insight in their current behaviour, we have chosen to include all 18 project leaders and all 39 PREDOCS nurses.

Within the PREDOCS programme, the roles of dedicated planner, cardiothoracic surgeon, manager and data manager are mostly represented by one participant in every cardiac surgery centre. For these roles, convenience sampling was used and we approached one participant per role in every subjected centre, resulting in a total of 48 participants representing these four roles over all cardiac surgery centres.

Assumed was that all ward nurses in the cardiothoracic ward potentially take care of PREDOCS patients in the postoperative period. Their main responsibility is to screen patients for the development of postoperative complications and to report this. To obtain a representative insight in the current behaviour of cardiothoracic ward nurses, we used a convenience sampling for this role and determined to include five ward nurses per subjected cardiac surgery centre, which resulted in a total sample of 60 ward nurses.

Based on our aforementioned determinations of sample sizes for every PREDOCS role, we aimed to include a total of 168 participants.

Data collection

This study aimed to measure the current behaviour of professionals in terms of capabilities, opportunities and motivations[13]:

1. Capability: the professional must have the knowledge, skills, psychological strength and stamina to organise, provide and enable the PREDOCS programme in a desired way.
2. Opportunity: to organise, enable and provide the PREDOCS programme, it must be *physically* accessible and affordable (what the environment allows or facilitates in terms of time, triggers, resources, locations, personnel and integration in the hospital information system) and *socially* acceptable, which concerns the feeling of a shared responsibility regarding one's tasks in the PREDOCS programme.
3. Motivation: professionals must be more highly motivated to organise, provide and enable the PREDOCS programme at the relevant time than to not do the desired behaviour. Motivation may be *reflective* (involving self-conscious planning and evaluations; beliefs about what is good and bad) or *automatic* (processes involving emotional reactions, desires, impulses or reflex responses).

Data collection took place between March 2018 and May 2018 through a self-administered questionnaire, the 'COM-B Self-Evaluation Questionnaire for PREDOCS' (COM-B-QP).

COM-B-QP

The COM-B-QP was developed for the present study and constructed systematically using the COM-B framework.[13] This framework, which originally consists of 23 items, aims to measure capabilities, opportunities and motivations to carry out a certain desired behaviour and originally focuses on recipients of an intervention. To use the framework as a base for the construction of our Dutch COM-B-QP, intended to diagnose professionals' behaviour in delivering an intervention, it first went through linguistic validation – a process of forward and

backward translation.

In order to ensure that the items of the COM-B-QP represented a comprehensive range of factors affecting professional behaviour involved in an implementation process, a content validation by two implementation scientists was performed. First, the items of the COM-B framework were assessed on relevancy, validity and reliability. This led to the elimination of six COM-B framework items which were not relevant for our population and setting. In order to increase the validity and comprehensiveness of the COM-B-QP, the Measurement Instrument for Determinants of Innovations (MIDI) was used subsequently to inform further questionnaire item construction.[26] This resulted in an addition of six MIDI items to our questionnaire. An overview of all items is presented in Table 3. Every behavioural (sub)component was represented in the COM-B-QP by at least one item.

(Table 3)

In order to address every participants' specific context in the PREDOCS programme, project leaders were first asked to deliver information about the division of PREDOCS roles in their hospital and the corresponding tasks of professionals representing these roles. Subsequently, the questionnaires were adjusted and specified to every role and every hospital. Some participants fulfilled multiple roles. In the latter case, participants received a questionnaire with items specified and corresponding to their different roles. In the analysis, we allocated the items to the roles where they belonged to. Participants reported the extent to which they agreed with the items on a 7-point Likert scale (1 = 'strongly disagree'; 7 = 'strongly agree'). A score of 7 ('strongly agree') was presented as the desired score for every item. The COM-B-QP was developed in Microsoft Word (Microsoft, Washington, USA).

Procedures

Project leaders were informed about this study by email in January 2018 and were instructed in March 2018 to spread the questionnaires to the right participants in their hospital, to collect them and send them back to the researchers. Instructions took place by email and by phone. Two reminders were sent via email to non-responders 2 weeks after the initial questionnaire had been sent.

Since all participants were already involved in the implementation study of the PREDOCS programme, we have chosen to not require informed consent of participants by using a

separate consent form. In the introduction of every questionnaire was stated that participants gave informed consent by filling out and returning the questionnaire.

Data analysis

Descriptive statistics were calculated to describe the characteristics of the healthcare professionals and the scores of the measured variables. Responses to the items of the COM-B-QP were used to construct composite capability, opportunity (physical and social) and motivation (automatic and reflective) scales. This was carried out per participant by calculating the mean score of every subcomponent. Subsequently, medians and interquartile ranges were calculated for every behaviour subcomponent stratified by role and by hospital. Medians and interquartile ranges were chosen because groups were mostly small ($n<10$) and/or not normally distributed. Thereby, using medians instead of means is recommended by experts when analysing Likert scale data (which are ordinal instead of numeric).[27,28]

In order to compare the median scores for capabilities, opportunities and motivations of every PREDOCS role across the different cardiac surgery centres, radar charts were used. Radar charts were chosen because it is a graphical method of displaying multivariate data in the form of a two-dimensional chart of multiple variables and it makes it easily possible to graphically compare the median scores across different groups. Data entry and descriptive analysis took place using IBM SPSS Statistics (IBM, Chicago, USA). For data visualization, we used Microsoft Excel (Microsoft, Washington, USA).

Missing values were excluded and median scores were based on the number of non-missing values. Percentages were adjusted by excluding missing responses.

Ethical issues

This study did not fall under the scope of the Medical Research Involving Human Subjects Acts (WMO). This was confirmed in January 2018 by the Medical Research Ethical Committee of the Utrecht University Medical Centre. The study is subject to the European General Data Protection Regulation (AVG). Study participants were informed that they gave informed consent for their anonymized data to be used for research through completing the questionnaire.

RESULTS

Response rate and baseline characteristics

A total of 93 health professionals completed the questionnaire, representing eleven cardiac surgery centres. Seventeen (18.3%) healthcare professionals were responsible for multiple roles in enabling and providing the PREDOCS-programme in their hospital. This resulted in a final sample of 113 cases, yielding a response rate of 67.3%. The response rate for PREDOCS nurses was 82.1% (n=32/39) and for project leaders 77.8% (n=14/18). The group of surgeons responded the least to the questionnaire with a response rate of 33.3% (n=4/12). Responding participants were predominantly female [n=103 (91.2%)] and the mean age of all participants in this study was 39.4 years. Response rates and baseline characteristics were stratified by role and presented in Table 4.

(Table 4)

COM stratified by PREDOCS role

The median scores of every subcomponent and its interquartile range were stratified by role and presented in Table 5. Every PREDOCS role reported a median score of 6.0 or higher for capability. Except for surgeons, all roles scored lowest on physical opportunity, median scores varied from 3.7 to 5.3. Surgeons scored lowest on automatic and reflective motivation (median score of 4.7 and 5.0 respectively).

(Table 5)

COM stratified by cardiac surgery centre

The median scores of every subcomponent and its interquartile range were stratified by cardiac surgery centre and presented in Table 6. The median score of the capability component varied from 5.5 to 7.0, which was the highest score of all subcomponents in six out of eleven cardiac surgery centres. The median score of physical opportunity was the lowest score in eight hospitals. In the three other hospitals, the score for social opportunity was the lowest of all measured components.

(Table 6)

COM stratified by cardiac surgery centre and PREDOCS role

In order to obtain more insight in the COM of the PREDOCS roles across the cardiac surgery centres, every role is presented in a radar plot wherein all subjected cardiac surgery centres are visualised separately (Figure 2 to Figure 8).

Figure 2 shows the COM of managers across eight cardiac surgery centres. It shows that the manager in hospital D scored lowest in all behavioural (sub)components and hospital I scored highest in four (sub)components. Highest variation is seen in social opportunity. Lowest scores are reported for physical opportunity.

(Figure 2)

Figure 3 shows the COM of PREDOCS nurses across eleven cardiac surgery centres. It shows that capability had the highest scores and lowest variation across all centres. More variation is seen in reflective motivation and physical and social opportunity, with outlying scores of hospitals C and D. This radar plot shows distinctive scores for social opportunity: PREDOCS nurses in six hospitals scored this subcomponent with a median score of 4.5 or lower, while PREDOCS nurses in the other five hospitals scored it with a median score of 6.0 or higher.

(Figure 3)

Figure 4 shows the COM of project leaders across nine cardiac surgery centres. Again, hospital C scored low outliers in three (sub)components. Project leaders also scored highest and with least variation on capability. Social opportunity showed the most variation and the lowest scores.

(Figure 4)

Figure 5 shows the COM of ward nurses across seven cardiac surgery centres. Hospital C scored lowest in automatic motivation and physical and social opportunity. Highest variation and lowest scores are seen in social opportunity. Again, capability scores were highest and most similar (ranging between 5.5 and 6.5).

(Figure 5)

Figure 6 shows COM of surgeons across four cardiac surgery centres. In contrast to the other PREDOCS roles, surgeons score highest on social opportunity and lowest on the motivation subcomponents.

(Figure 7)

Figure 7 shows the COM of planners across seven cardiac surgery centres. Most variation and lowest scores are seen in physical and social opportunity. Scores in capability and the motivation subcomponents are similar across hospitals.

(Figure 8)

Figure 8 shows the COM of data managers. The subcomponents of opportunity are scored with highest variation and four hospitals scored them with a 4.5 or less. Hospital G scored the desired score of 7.0 in all subcomponents.

Missing values

Missing data were sparse and did not show any perceptible patterns. No individual item was missed more than four times and only two respondents had missing information for more than two items. Missing data was considered missing completely at random (MCAR) and were excluded from the analysis.

DISCUSSION

This study identified the capabilities, opportunities and motivations of the current behaviour of professionals involved in the PREDOCS programme. Our results show that professionals in different roles across all cardiac surgery centres are capable to perform their desired behaviour regarding PREDOCS; their knowledge, mental skills and strength are reported to be sufficient. In general, our findings identified social and physical opportunity as components that need to change most in the majority of hospitals in order to achieve the desired change in behaviour.

Main findings

In our findings, inter-hospital differences were present; three hospitals scored relatively high on all subcomponents, with similar results across the PREDOCS roles. Higher scores for motivation seemed to be accompanied by higher scores for capability. These findings are in line with Michie et al who state that increasing opportunity and capability can increase

motivation directly.[13] Besides, the aforementioned hospitals had a high response rate, which could be a sign of a high level of engagement regarding the implementation of PREDOCS. Some hospitals reported consistently lower scores on social and physical opportunity across all PREDOCS roles. Hospitals' reasons for these low scores, sometimes explicitly reported in the comment fields, were mainly the shortage of personnel or time, a lack of feeling supported by management or colleagues and insufficient space to conduct the PREDOCS consultations. This is in line with Zamanzadeh et al who reported a lack of support from management systems and a lack of enough time as major barriers in implementation processes.[29] In addition, a large systematic review of Carlson et al found insufficient time as the most important barrier for research utilization among nurses.[30] Our finding that capability and motivation scores were often scored higher than opportunity is also in line with Carlson et al, who stated that nurses in Western Countries generally feel capable in the uptake of new evidence based practices and often see the value of the implementation of new evidence.[30]

Low scorings can also be explained by possibly high experienced burden and poor embedding of the intervention, since some professionals had the responsibility for three or four roles. Besides, some hospitals with lower scores just recently started with the implementation process of the PREDOCS programme and were still preparing on the required materials, space and trained personnel at the time of data collection.

The surgeons could be seen as exceptions; they scored lowest on motivation and highest on social opportunity. This can be explained by the fact that their behaviour in the PREDOCS programme hardly depends on materials or required space. As only four surgeons responded to the questionnaire, the reliability of data regarding this role is questionable. In addition, ward nurses scored relatively low on motivation too. This can be explained by the fact that both professionals are less involved in the PREDOCS programme than for example project leaders and PREDOCS nurses, and therefore feel less motivated. Two surgeons reported in the comment field that they also apply other (medical) interventions to reduce the risk of postoperative complications and do not consider the PREDOCS programme as very effective.

Strengths and limitations

To our knowledge, this is among the first applications of the COM-B model to inform and analyse behaviour of professionals delivering a complex nursing intervention. One of the strengths of this inquiry was the use of a context-based questionnaire which was completely

specified to the PREDOCS programme and the desired behaviour of involved participants per hospital. This ensured that all items were relevant for participants and it increased the validity of our questionnaire. The construction and specification process of the COM-B-QP is similar to the one of Taylor et al, a survey to measure COM in obese children. They also used the COM-B, an additional framework and a 7-point Likert scale for questionnaire construction and concluded this was a suitable, systematic and comprehensive approach to measure behaviour components in a specific context.[25]

On the other side, the content of our questionnaires differed between roles and hospitals and were not one-on-one comparable. It also has to be taken into account that the number of items per behavioural component was variable, which could have led to some bias. Especially the 'social opportunity' component, which was represented by only one item, was therefore more sensitive for outlying answers. Besides this, adjusting questionnaires per role and hospital, which also implied deleting irrelevant items, led to more variability in the number of items answered per participant.

We have chosen to distribute the questionnaire via the project leader(s) of every hospital. This was an advantage by manner that communication was done through one person who knew all the participants from their hospital personally, which could have increased the response rate. On the other side, this caused probably more delay in some cases, as project leaders were sometimes difficult to reach.

CONCLUSION

Our study identified the components of the current behaviour of professionals involved in the implementation process of the PREDOCS programme. In general, social and physical opportunity were identified as most important behavioural components to target in order to improve the implementation process of PREDOCS. However, inter-hospitality differences were seen, and motives for lower scorings were clearly context dependent. This study forms a starting point to find appropriate behaviour change techniques in order to advance the implementation process of the PREDOCS programme in the Netherlands.

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TABLES AND FIGURES

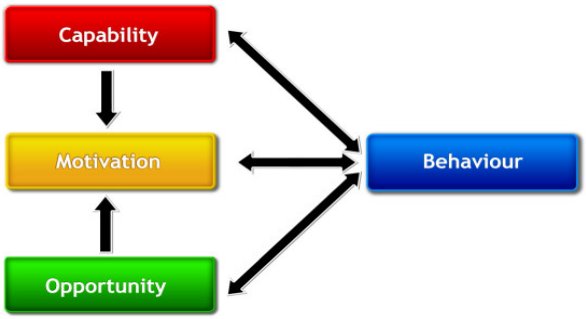

Figure 1. *The COM-B model – a framework for understanding behaviour.*[13]

Table 1. PREDOCS roles, corresponding main tasks and possible representing types of professionals.

PREDOCS role	Main tasks within PREDOCS	Possible representing professionals
PREDOCS project leader	Coordinating the implementation of PREDOCS in their hospital + hospitals contact person for PREDOCS researchers	General nurse Medium Care nurse (Nursing) Team leader (Nursing) Unit manager Cluster manager Cardiothoracic surgeon Quality manager
PREDOCS nurses	Conducting the PREDOCS consultation	General nurse Medium Care nurse Nurse practitioner
Managers	Organising and enabling personnel, time and space for PREDOCS.	Team leader (Nursing) Unit managers Cluster managers
General ward nurses	Screening patient for the development of postoperative complications + supporting patient in postoperative period with PREDOCS preventive measures	General nurse Medium Care nurse

Table 1 (continued). PREDOCS roles, corresponding main tasks and possible representing types of professionals.

PREDOCS role	Main tasks within PREDOCS	Possible representing professionals
Cardiothoracic surgeons	Reconsidering planned cardiothoracic surgery in frail older patient at risk / discussing results PREDOCS consultation in cardio team meeting	Cardiothoracic surgeons
Planners	Planning of PREDOCS consultation + inviting patient	Planning officers Secretary General nurse
Data managers	(Designing of) database for registration of postoperative complications + deliver registration to PREDOCS project leaders/researchers	General nurse Medium care nurse Quality manager Application manager Nurse practitioner Data manager

Table 2. Cardiac surgery centres currently implementing the PREDOCS programme.

University Hospitals	Top Clinical Hospitals (STZ[a])
Amsterdam Medical Centre (AMC)	Amphia Hospital, Breda
Maastricht University Medical Centre (MUMC)	Haga Hospital, The Hague
University Medical Centre Utrecht (UMCU)	Isala Hospital, Zwolle
Vrije Universiteit Medical Centre, Amsterdam (VUmc)	Medical Centre Leeuwarden (MCL)
Radboud Medical Centre, Nijmegen	Medical Spectrum Twente, Enschede (MST)
	Onze Lieve Vrouw Gasthuis, Amsterdam (OLVG)
	St. Antonius Hospital, Nieuwegein

[a] *Samenwerkende Topklinische opleidingsZiekenhuizen*

Table 3. An overview of items of the COM-B-QP[a]	
COM-B model (sub)component	**Corresponding items, used in the questionnaire**
Capability - Psychological	Level of knowledge about the intervention (4 levels) (MIDI[b]) Know why it is important Know how to do it Have sufficient mental skills Have sufficient mental strength/perseverance Can deal with setbacks
Opportunity - Physical	Have enough time Sufficient implemented in the hospital information system Have the necessary materials Have enough space No reminders needed/sufficient adopted in current work process Sufficient measures to replace leaving personnel on time (MIDI[b]) Sufficient policy for enough personnel (MIDI[b]) Are there formal agreements about the use of the intervention? (MIDI[b]) Are there other changes/reorganisations/implementations happening at the same time? (MIDI[b])
Opportunity - Social	Have support from others
Motivation - Automatic	Feel that they want to do it enough Developed a habit of doing it Feel that it is part of existing work process
Motivation - Reflective	Feel that it is needed Believe that it is a good thing to do Fits well with usual manner of working Feels that it belongs to their professional function Effects are visible enough Feedback on a regular basis (MIDI[b])
[a]COM-B-QP: COM-B Self-Evaluation Questionnaire for PREDOCS *[b]MIDI: Measurement Instrument for Determinants of Innovations (MIDI)*	

Table 4 Demographic characteristics stratified by role

	Project leader (n=14)	**PREDOCS nurse/NP[a]** (n=32)	**Ward nurse** (n=35)	**Manager** (n=10)	**Planner** (n=8)	**Surgeon** (n=4)	**Data manager** (n=10)	**Total** (n=113)
Response rate	77.8% (n=14/18)	82.1% (n=32/39)	62.5% (n=35/56)	71.4% (n=10/14)	61.5% (n=8/13)	33.3% (n=4/12)	66.7% (n=10/15)	67.3% (n=113 /168)
Age in years (median (IQR[b]))	32.5 (28.8-49.0)	46.5 (28.3-56.5)	26.0 (24.0-30.0)	48.0 (40.5-51.5)	54.0 (48.0-60.0)	49.5 (44.8-57.3)	51.0 (29.5-58.0)	38.0 (27.0-52.0)
Gender								
Male (%)	1 (7.1)	1 (3.1)	2 (5.7)	4 (40.0)	0	2 (50.0)	0	10 (8.8)
Female (%)	13 (92.9)	31 (96.9)	27 (94.3)	6 (60.0)	8 (100)	2 (50.0)	10 (100)	103 (91.2)
Years of work experience in current profession (median (IQR))	6.3 (3.0-12.8)	8 (3.0-20.0)	3.0 (2.0-8.0)	7.5 (4.0-13.5)	10.5 (3.3-17.8)	15.5 (9.5-21.5)	5.5 (3.3-22.8)	6.0 (3.0-14.8)
Education (%)								
Sec. educ.	0	3 (9.4)	0	0	3/7 (42.9)	0	2 (20.0)	8/112 (7.1)
Sec. voc.	0	11 (34.4)	10 (28.6)	0	2/7 (28.6)	0	2 (20.0)	25/112 (22.3)
Bachelor's	6 (42.9)	12 (37.5)	24 (68.6)	2 (20.0)	1/7 (14.3)	0	3 (30.0)	48/112 (42.9)
Master's	5 (35.7)	6 (18.8)	1 (2.9)	8 (80.0)	1/7 (14.3)	1 (25.0)	1 (10.0)	23/112 (20.5)
PhD	3 (21.4)	0	0	0	0	3 (75.0)	2 (20.0)	8/112 (7.1)

[a]*Nurse Practitioner*

[b]*Interquartile range*

In case of missing values or other denominator than all hospitals, the denominator is given

Table 5. COM stratified by PREDOCS role, median (IQR[a])

	Manager (n=10)	**PREDOCS nurse/NP[b]** (n=32)	**Project leader** (n=14)	**Ward nurse** (n=35)	**Surgeon** (n=4)	**Planner** (n=8)	**Data manager** (n=10)	**Total** (n=113)
Capability	6.5 (6.4-7.0)	6.2 (6.0-6.8)	6.3 (6.0-6.7)	6.0 (5.5-6.0)	6.0 (3.8-6.0)	6.5 (6.0-6.9)	6.5 (5.5-7.0)	6.2 (5.8-6.5)
Opportunity								
Physical	4.9 (3.5-5.6)	5.3 (4.1-6.0)	4.2 (3.9-5.7)	4.3 (3.7-5.0)	5.5 (4.3-6.4)	4.3 (3.3-5.9)	3.7 (3.3-5.6)	4.3 (3.7-5.7)
Social	5.0 (3.8-6.25)	5.5 (3.3-6.0)	4.5 (3.0-6.0)	5.0 (4.0-6.0)	6.0 (6.0-6.8)	6.0 (2.8-6.0)	5.5 (3.8-7.0)	5.0 (4.0-6.0)
Motivation								
Automatic	6.0 (5.8-7.0)	6.0 (5.3-7.0)	5.8 (5.0-6.6)	5.0 (4.7-6.0)	4.7 (3.3-5.8)	5.5 (5.0-6.5)	5.7 (4.8-7.0)	5.7 (5.0-6.5)
Reflective	5.7 (5.3-6.5)	5.8 (5.3-6.4)	5.9 (5.2-6.4)	5.0 (4.7-5.8)	5.0 (4.5-5.8)	6.0 (5.5-6.8)	6.7 (6.2-7.0)	5.7 (5.0-6.3)

[a]*Interquartile range*

[b]*Nurse Practitioner*

1 = strongly disagree, 2 = disagree, 3 = more or less disagree, 4 = neutral,

5 = more or less agree, 6 = agree, 7 = strongly agree

Table 6. COM stratified by cardiac surgery centre, median (IQR[a])

	A (n=7)	B (n=2)	C (n=10)	D (n=4)	E (n=21)	F (n=12)	G (n=15)	H (n=15)	I (n=11)	J (n=3)	K (n=13)
Capability	6.5 (6.4-7.0)	7.0 (-)	6.0 (5.6-6.1)	5.5 (4.3-6.0)	6.4 (6.0-6.9)	6.2 (5.3-6.5)	6.0 (5.5-6.4)	6.0 (5.8-6.5)	6.8 (6.0-7.0)	6.0 (5.6-.6.0)	6.0 (5.9-6.5)
Opportunity											
Physical	3.0 (2.8-3.8)	5.5 (-)	3.5 (2.9-4.0)	4.2 (3.6-5.6)	4.3 (3.8-5.4)	5.7 (4.5-6.3)	4.9 (4.0-6.0)	5.3 (4.3-6.0)	6.0 (5.5-6.6)	3.8 (3.6-4.0)	4.0 (3.2-4.2)
Social	3.0 (2.0-6.0)	6.5 (-)	3.0 (2.0-4.3)	3.5 (3.0-5.5)	5.0 (4.0-6.0)	6.0 (3.5-6.8)	5.0 (4.0-6.0)	6.0 (5.0-7.0)	6.0 (6.0-7.0)	3.0 (3.0-6.0)	5.0 (3.5-5.0)
Motivation											
Automatic	6.0 (5.0-7.0)	7.0 (-)	5.3 (4.5-5.8)	6.0 (4.0-6.0)	5.5 (5.0-6.8)	6.3 (5.7-7.0)	5.3 (5.0-6.0)	6.0 (5.3-6.5)	6.3 (5.8-6.8)	5.0 (3.7-5.0)	5.0 (4.0-5.2)
Reflective	6.2 (5.8-7.0)	7.0 (-)	4.7 (3.8-5.2)	5.2 (4.6-5.2)	6.0 (5.3-6.3)	6.3 (5.5-7.0)	5.0 (4.7-5.4)	6.4 (5.8-6.8)	6.0 (5.7-6.2)	5.2 (5.2-5.5)	5.5 (4.8-6.0)

[a]*Interquartile range*

1 = strongly disagree, 2 = disagree, 3 = more or less disagree, 4 = neutral, 5 = more or less agree, 6 = agree, 7 = strongly agree

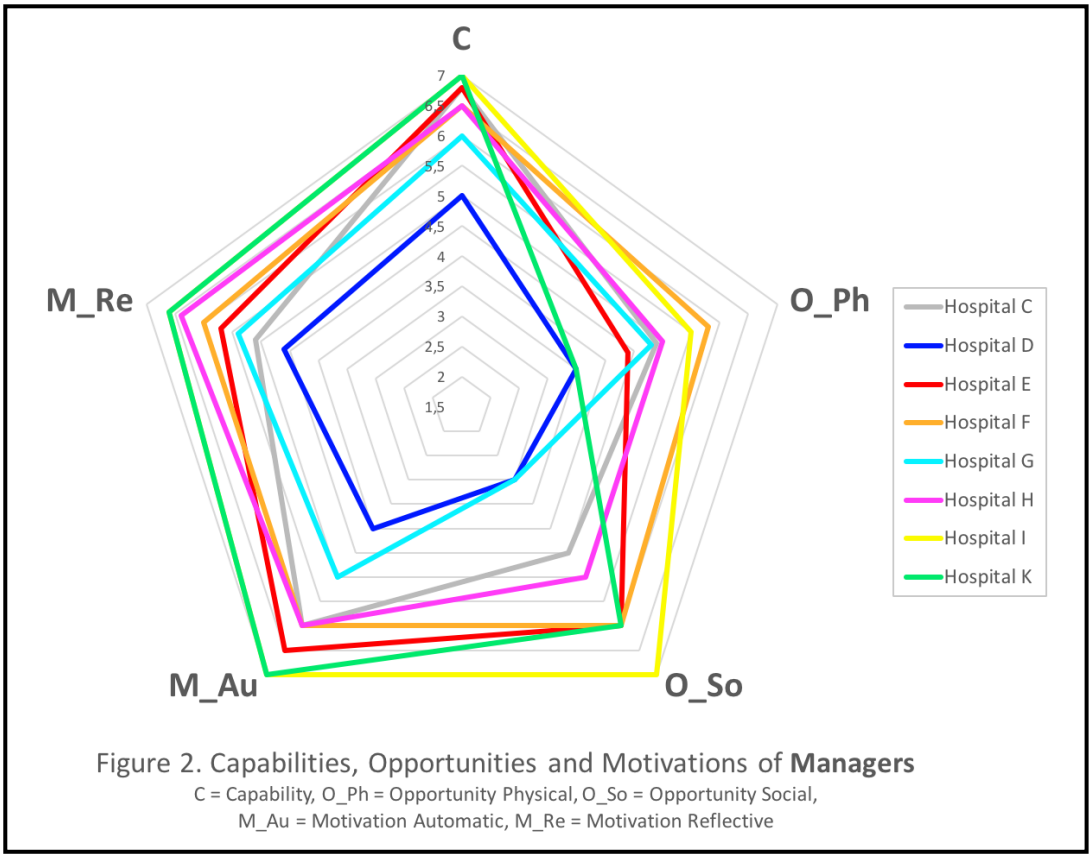

Figure 2. Capabilities, Opportunities and Motivations of **Managers**

C = Capability, O_Ph = Opportunity Physical, O_So = Opportunity Social,
M_Au = Motivation Automatic, M_Re = Motivation Reflective

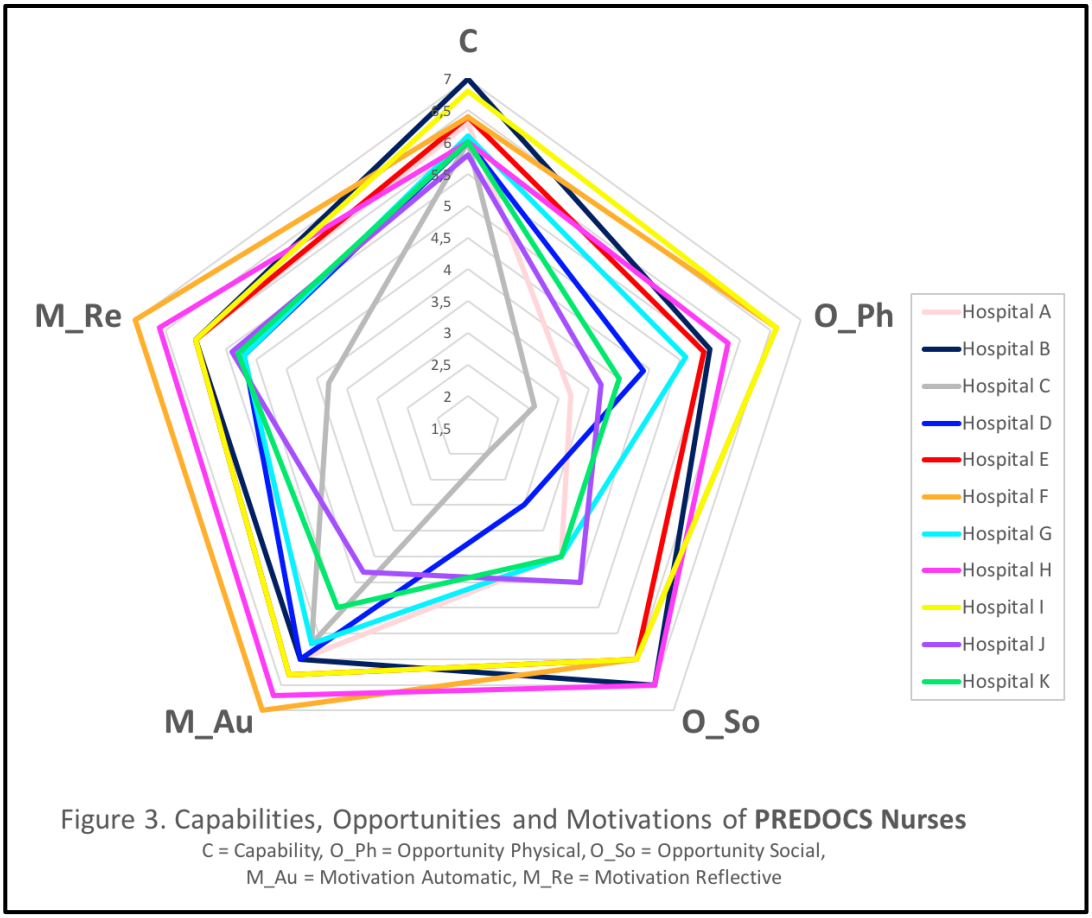

Figure 3. Capabilities, Opportunities and Motivations of **PREDOCS Nurses**

C = Capability, O_Ph = Opportunity Physical, O_So = Opportunity Social,
M_Au = Motivation Automatic, M_Re = Motivation Reflective

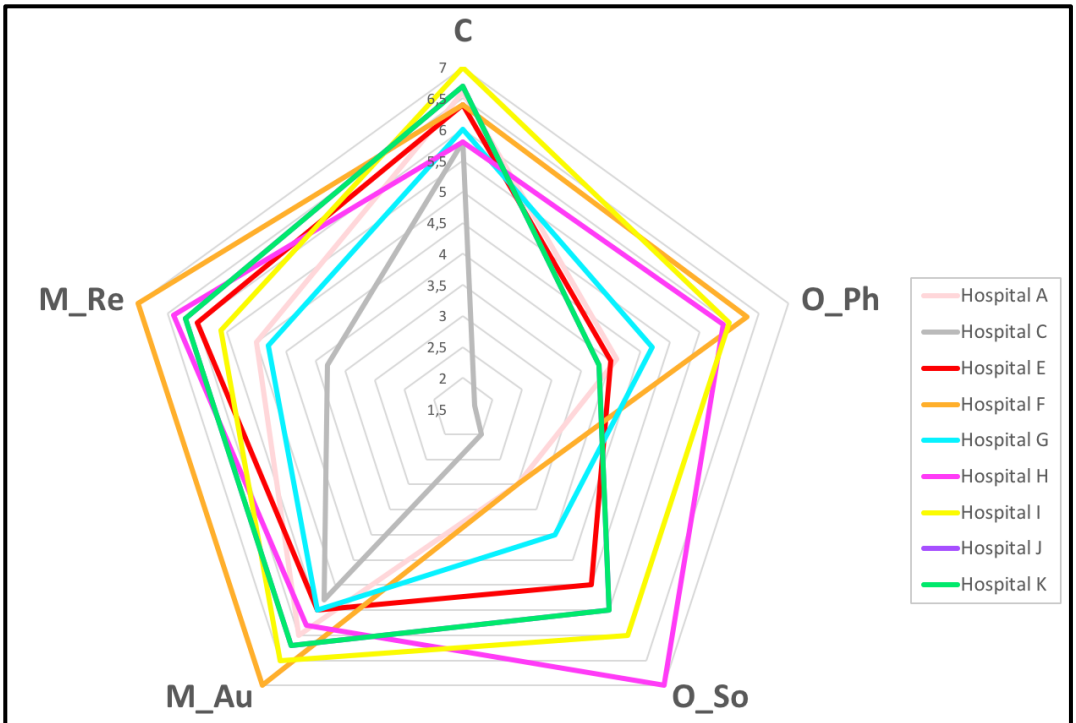

Figure 4. Capabilities, Opportunities and Motivations of **Project leaders**
C = Capability, O_Ph = Opportunity Physical, O_So = Opportunity Social,
M_Au = Motivation Automatic, M_Re = Motivation Reflective

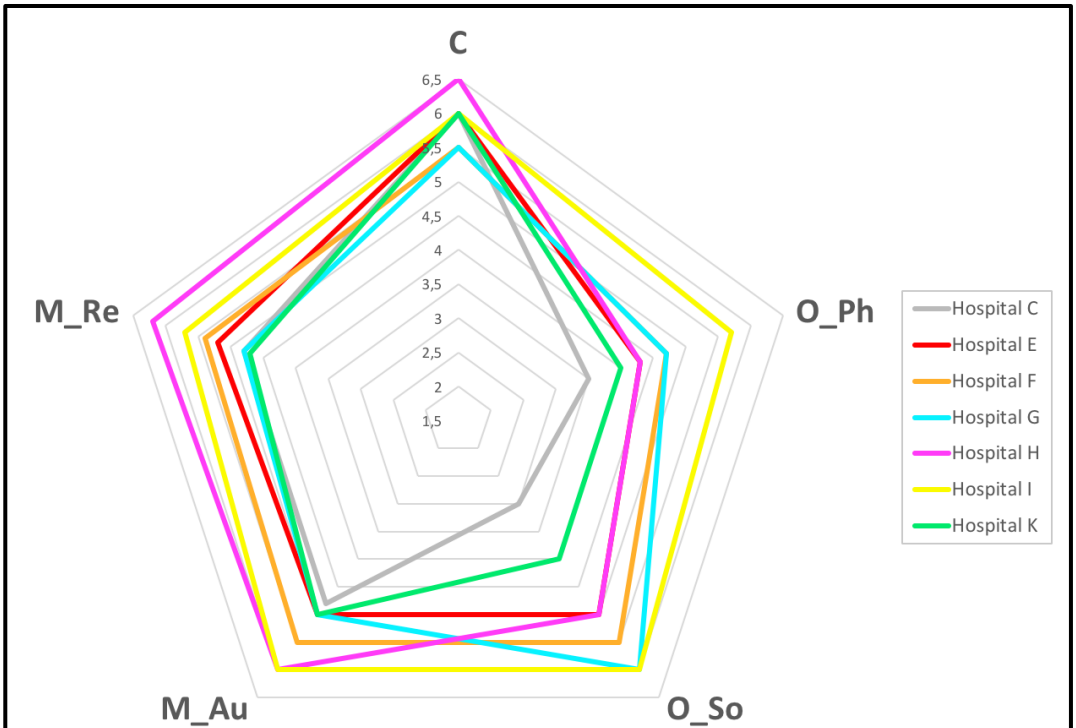

Figure 5. Capabilities, Opportunities and Motivations of **Ward Nurses**
C = Capability, O_Ph = Opportunity Physical, O_So = Opportunity Social,
M_Au = Motivation Automatic, M_Re = Motivation Reflective

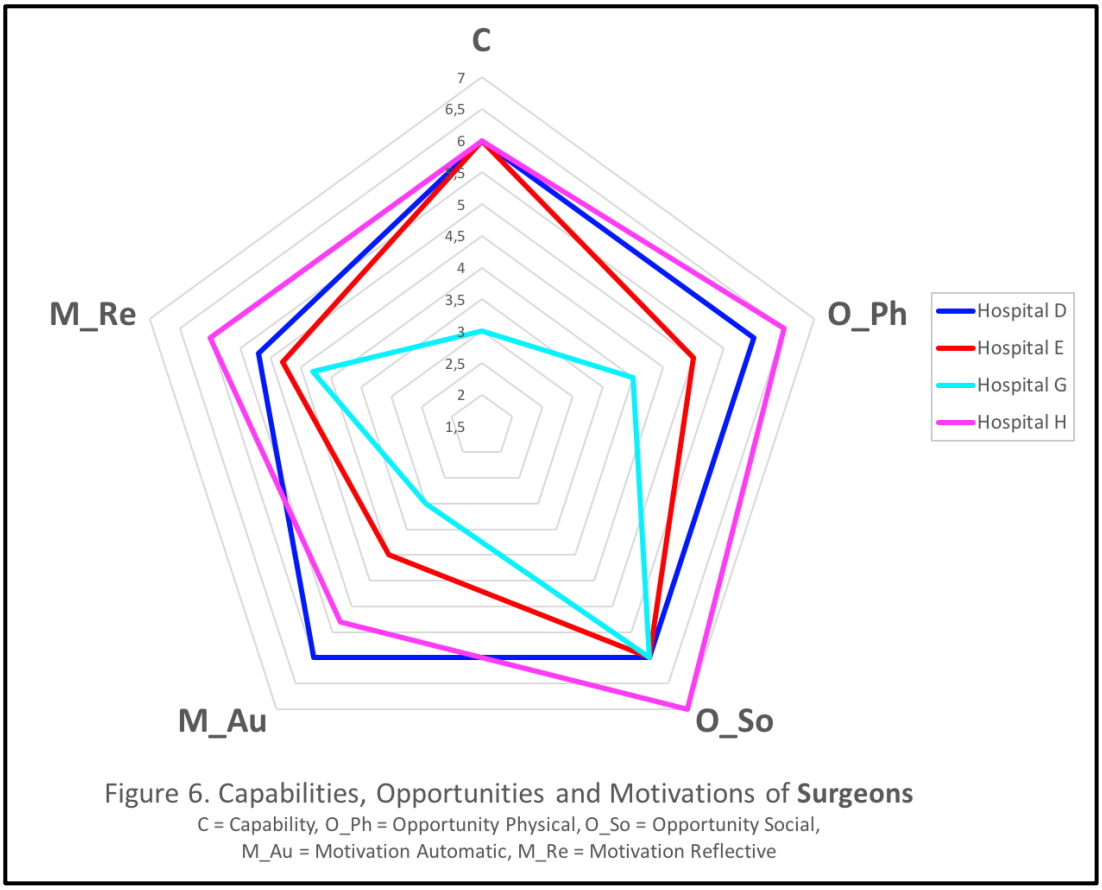

Figure 6. Capabilities, Opportunities and Motivations of **Surgeons**
C = Capability, O_Ph = Opportunity Physical, O_So = Opportunity Social,
M_Au = Motivation Automatic, M_Re = Motivation Reflective

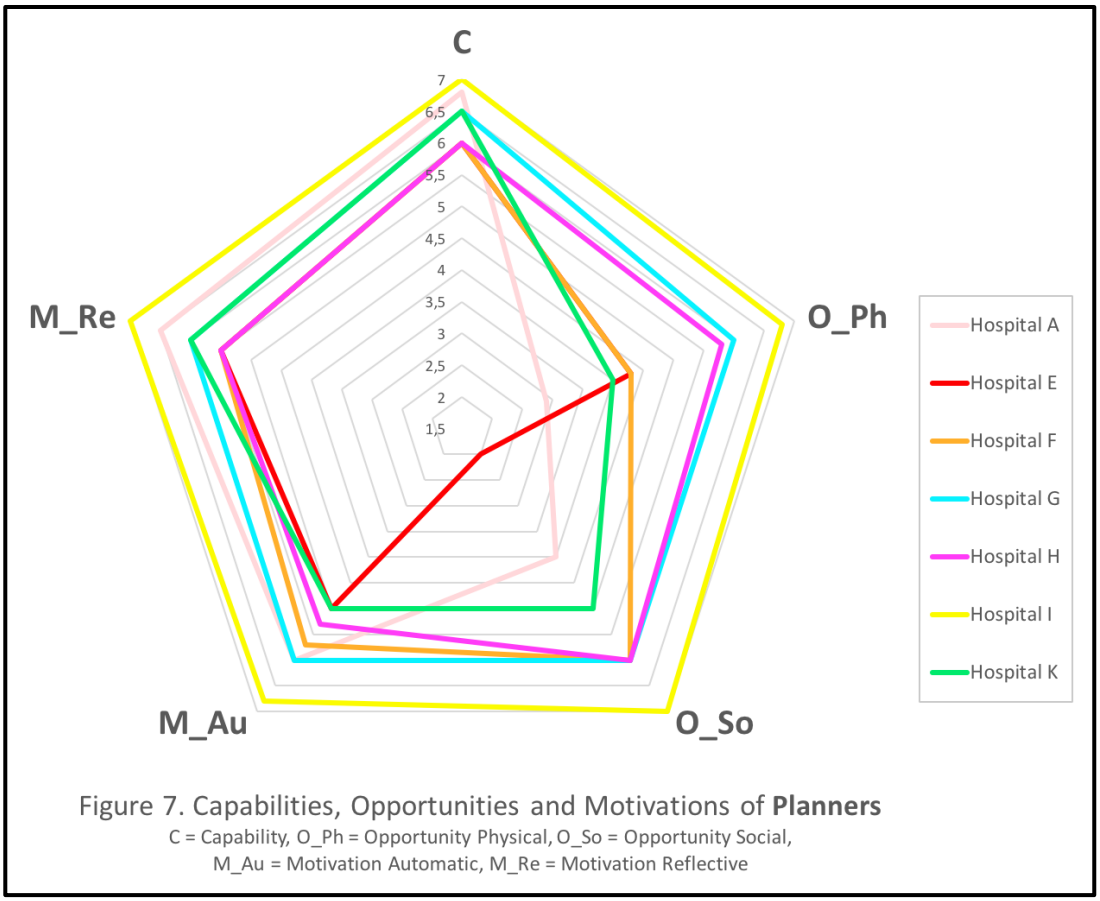

Figure 7. Capabilities, Opportunities and Motivations of **Planners**
C = Capability, O_Ph = Opportunity Physical, O_So = Opportunity Social,
M_Au = Motivation Automatic, M_Re = Motivation Reflective

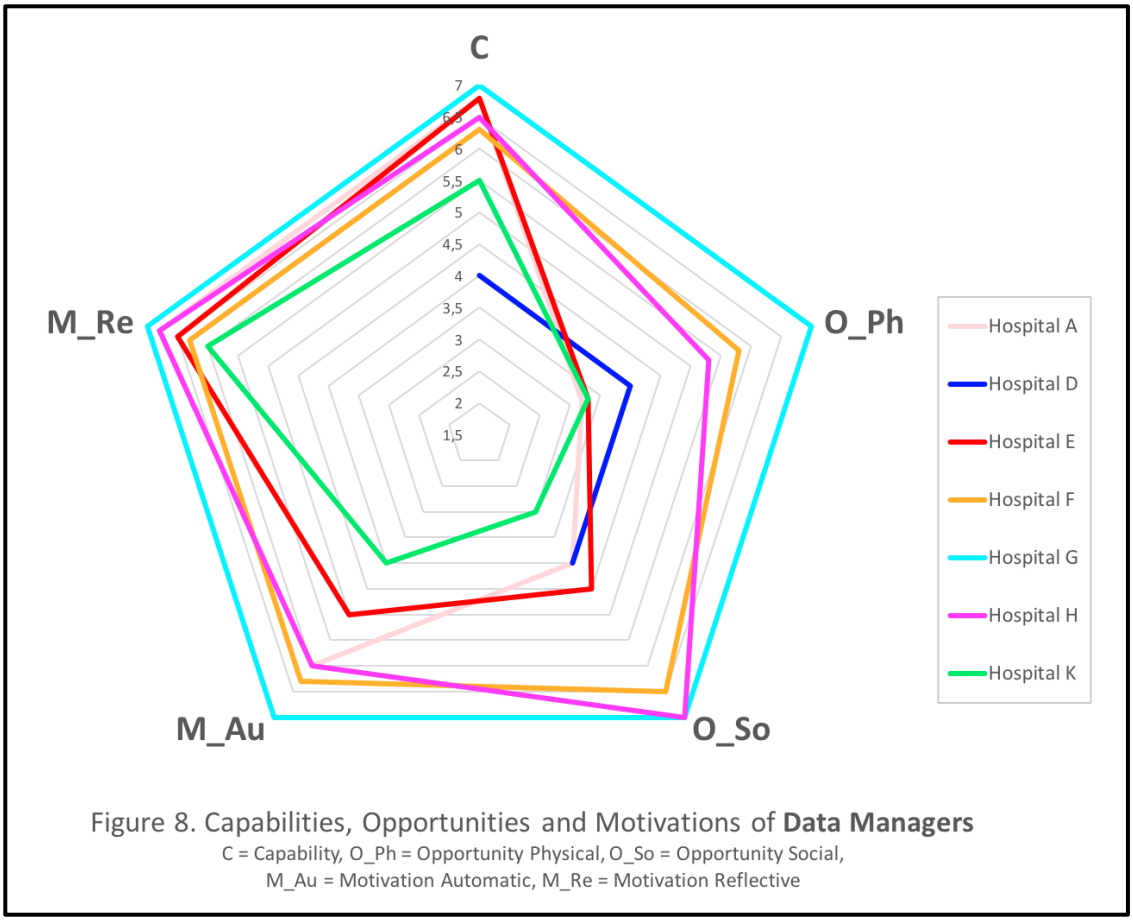

Figure 8. Capabilities, Opportunities and Motivations of **Data Managers**
C = Capability, O_Ph = Opportunity Physical, O_So = Opportunity Social,
M_Au = Motivation Automatic, M_Re = Motivation Reflective