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Incorporating Value-based Healthcare Projects in Residency Training:

A mixed methods study on the impact of participation on understanding & competency development

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34 **Abstract**

35 **Objectives:** Residency training programs have changed to competency-based education. Stimulating
36 active participation of residents in actual and societal relevant themes in healthcare, such as Value-
37 Based Healthcare (VBHC), can be a strategy to support competency development. In this study we
38 hypothesize that when residents conduct a VBHC project, CanMEDS competencies are learned. As
39 extra revenue, knowledge about VBHC is gained and skills to apply VBHC are learned at the same time.

40 **Methods:** An explorative mixed-methods study amongst residents in training, in academic and non-
41 academic hospitals in the Netherland, was conducted. We assessed residents' self-perceived learning
42 effects of conducting VBHC projects on three main components: (i) CanMEDS competency
43 development, (ii) the recognition of VBHC dilemmas in clinical practice, and (iii) potential facilitators
44 for and barriers to implementing a VBHC-project. We triangulated the data resulting from qualitative
45 analyses of: (a) text-based summaries of VBHC projects by residents, and (b) semi-structured
46 interviews with residents who conducted these projects.

47 **Results:** 56 text-based summaries and 11 semi-structured interviews were included in the final
48 analysis. Regarding CanMEDS competencies development the competencies 'leader', 'communicator'
49 and 'collaborator' scored highest. Opportunities to recognize VBHC dilemmas in practice were mainly
50 stimulated by analyzing healthcare practices from different perspectives, and by learning how to relate
51 and define costs to value. Finally, implementation of VBHC projects is, amongst others, facilitated by a
52 thorough investigation of a VBHC dilemma combined with an in-depth stakeholder analysis.

53 **Conclusion:** In medical residency training programs, competency development, by active participation
54 in an actual (or emerging) and societal relevant theme in healthcare - such as VBHC - was found a
55 promising strategy. From a residents' perspective combining a thorough investigation of the VBHC
56 dilemma with an in-depth stakeholder analysis is key to successful implementation of a VBHC project.

57

58

59 **Strengths and limitations of this study**

- 60 • Small sample size, especially in semi-structured interviews.
- 61 • Only projects that were thought to be viable for implementation led by residents with the
62 intrinsic motivation to make a change were publicised and therefor selected, which could lead
63 to overestimation of results.
- 64 • CanMEDS competency development was self-reported.
- 65 • Due to the nature of the semi-structured interviews it will be difficult to replicate this data.

67 **Key words**

- 68 • Value-Based Healthcare
- 69 • Residency training programs
- 70 • Competency-based education
- 71 • CanMEDS competencies

73 **Background**

74 The Canadian Medical Education Directions for Specialist (CanMEDS) project contributed to a major
75 change in (postgraduate) medical education moving away from a time-based learning system, to a
76 competency-based learning system (1). It described important competencies medical residents should
77 master during their training, such as communicator, collaborator, leader and health advocate (2).
78 However it appears that the `soft` competencies such as `leader` and `health advocate` are neither
79 easy to teach, nor to assess (3). Educational efforts that specifically train these competencies are
80 therefore appreciated.

81 In addition to the CanMEDS competencies, and to assure that physicians' competencies align
82 with evolving health systems, overarching themes focusing on societal needs and future demands are

1
2
3 83 increasingly integrated into medical education (4). Examples of such themes are patient safety, shared
4
5 84 decision-making, and value-based health care (5-7). In the Netherlands, educators experienced the
6
7 85 urge to combine these developments. This resulted in the so-called CanBetter project (7), which
8
9 86 started in 2015. The project meant linking development of all CanMeds competencies with teaching
10
11 87 residents about societal relevant themes. Value-based healthcare (VBHC) was one of the current
12
13 88 relevant themes the CanBetter project focusses on, because health care expenditure is rising and
14
15 89 medical professionals need to take their responsibility (8).

16
17
18
19 90 VBHC is defined as the health outcome that matters to the patient, relative to the costs of
20
21 91 achieving this outcome (8). Health outcomes can be, for example, disease free survival for patients
22
23 92 with cancer, or the time needed to regain functionality after a knee joint replacement (8). Despite
24
25 93 achieving health outcomes, professionals also carry responsibility for stewardship of resources; which
26
27 94 requires an entirely new way of managing (9). Therefore instruction, training and fundamental
28
29 95 knowledge on VBHC is required (10-12). Past efforts to teach residents about cost-effective care
30
31 96 unfortunately have not always been as effective as intended (13, 14) for example, because medical
32
33 97 education didn't provide a positive culture, the training environment was not suitable, or difficulties
34
35 98 arose when changing practice patterns of both residents and supervising faculty (14).

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39 99 Recent research illustrated that key elements of learning to deliver VBHC are knowledge
40
41 100 transmission, appropriate role modelling, reflection and presence of a supportive environment (10).
42
43 101 Medical students and residents must be educated and trained in settings where they have
44
45 102 opportunities to develop and use VBHC; preferably in a clinical setting (15-17). Amongst others, a
46
47 103 specific training program, incorporating formal and informal learning is necessary to learn how to
48
49 104 deliver VBHC (18). The residency training programs are believed to be one of the best places to initiate
50
51 105 VBHC education because residents are adaptable, highly educated and motivated. In addition, it is
52
53 106 shown, that what residents learn during their residency has a significant impact on how they treat their
54
55 107 patients when they are medical specialists (19).

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3 108 In our regional organization of teaching hospitals strategy was set up combining formal and
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5 109 informal training, within the residency training program, getting residents involved with VBHC.
6
7 110 Residents were stimulated to critically assess daily healthcare and recognize potential VBHC dilemmas
8
9
10 111 and transform this into a VBHC project. Such VBHC-projects are resident-led and practice-based.

11
12 112 This study evaluates the impact of incorporating VBHC projects within the residency training
13
14 113 program. The following research questions were formulated: (I) 'Which CanMEDS competencies do
15
16 114 residents develop, when conducting VBHC projects in residency training?' (II) 'Is recognition of VBHC
17
18 115 dilemmas in medical practice facilitated when residents conduct VBHC projects during residency
19
20 116 training program?', (III) 'Which facilitators for and barriers to VBHC project implementation can we
21
22 117 detect when conducting a VBHC project during residency training?'.
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119 **Methods**

120 ***Study Design***

121 An explorative mixed-methods design was used. The study entailed an analysis of retrospective
122 information of VBHC projects, conducted by residents between 2014 and 2018 via text-
123 based summaries of VBHC projects, and semi-structured interviews with residents. The text-based
124 summaries were retrieved via the "standard format for VBHC projects", (see appendix 1 for the
125 format), which are publicly available in Dutch via a webpage (20).
126

126

127 ***Ethical approval***

128 Ethical approval was provided by the Dutch Association for Medical Education (NVMO) on the 19th of
129 June 2017 (ID number 915).
130

130

131 ***Patient and public involvement***

132 Unfortunately there was no Patient and Public Involvement in this study. Patient involvement was not
133 applicable as there are no Patients involved.

133

134

135 **Setting**

136 This study focused on the postgraduate training setting (residency training) in the Southeast region of
 137 Netherlands. *Table 1* presents a general overview of the Dutch medical undergraduate and
 138 postgraduate training programs. The region of study has chosen to apply a multifaceted approach of
 139 incorporating VBHC in residency training, by having residents conduct small, pragmatic initiatives
 140 called “VBHC projects”. At the time of study, VBHC training and projects were not mandatory, though
 141 much stimulated as a method for residents to learn about VBHC in different ways.

142

143 *Table 1. Overview of general characteristics of the Dutch undergraduate and postgraduate training*
 144 *programs*

Name and structure	Duration	Qualification after graduation
Preclinical training (bachelor)	3 years	Bachelor of medicine
Clinical training (master)	3 years	Physician, M.D.
Resident not in training	Optional	-
Residency training or training for general practitioner	3 to 6 years	Medical specialist, general practitioner

145

146 **The VBHC projects**

147 Residents were stimulated to critically assess daily healthcare and recognize potential VBHC dilemmas
 148 in practice. These dilemmas entail a wide range of problems or possibilities of improvement residents
 149 would come across. For example inefficiency in logistics, unnecessary costs spent on diagnostics, or a
 150 new treatment with less complications. Residents were then guided step-by-step. Firstly, they were
 151 offered knowledge and skills to identify, measure and value both costs and outcome. Secondly,
 152 residents were encouraged to discuss VBHC dilemmas with relevant stakeholders, consequently
 153 assessing the dilemma from multiple perspectives. These perspectives, for example, could be the
 154 patient`s, the doctor`s, that from other health care professionals and/or that from the health care
 155 organisation as a whole. Thirdly, residents had to determine goals for improvements or search an
 156 effective alternative for current clinical practice. Finally, residents reported to each other how they

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3 157 implemented their change or planned how they were going to implement there change, what
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5 158 (potential) facilitators and barriers they foresaw or encountered and what they learned during the
6
7 159 process. Altogether, this resulted in a VBHC-project. In order to enhance the chance of successfully
8
9 160 conducting such a project the residents were stimulated to keep the projects relatively small-scale, i.e.
10
11 161 with the goal to finish this within approximately 3 to 6 months.
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13
14 162

16 163 ***Data collection and analyses***

18 164 *Data collection & Analyses of Text-Based Summaries*

19 165 VBHC projects were included in this study when a standard format was completed and published online
20
21 166 at the publicly available webpage (20) including a clear problem statement, and potential costs and
22
23 167 effects identified as measured and valued from multiple perspectives (at least 2). In case of incomplete
24
25 168 data, an email and one reminder email were sent to request missing information. In case of persisting
26
27 169 incomplete data, the VBHC project was excluded.
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32 170 The final set of included VBHC projects was assessed by two independent researchers (CN, SV).
33
34 171 Data extraction of the included VBHC projects concerned a summary of setting, medical specialty,
35
36 172 focus of the project, aimed and achieved results and learning effects in terms of residents' self-
37
38 173 perceived CanMEDS competency development. Furthermore, data extraction yielded a scoring for
39
40 174 learning effects in terms of residents' self-perceived CanMEDS competency development. Any
41
42 175 disagreements were resolved through discussion. Focus of the projects were categorised as medical
43
44 176 education, medical care and/or organisational efficiency. The category medical education included
45
46 177 projects that aimed to improve education for residents, either in terms of practical skills or theoretical
47
48 178 knowledge. The category medical care included projects that focused on improvement in current
49
50 179 quality of care and/or direct reduction of healthcare costs. The category organisational efficiency
51
52 180 included projects that aimed to optimise processes in healthcare.
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59 182 *Data Collection & Analyses of Semi-structured Interviews*

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3 183 Semi structured interviews were held with residents who conducted a VBHC project and published this
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5 184 in the online publicly available database (20). After initial resident contact, a reminder request was
6
7 185 sent in case of non-response. All interviews were performed, by telephone or face-to-face by one
8
9
10 186 investigator (MK) under supervision of a trained interviewer (CN). There was no prior relationship
11
12 187 between the interviewer and the interviewees before the start of the study. Before the included
13
14 188 interviews were performed, a series of pilot interviews were held to train the interviewer and asses
15
16 189 the quality and feasibility of the topic list. The final topic list for the semi-structured interviews can be
17
18 190 found in appendix 2. In short, residents were asked to provide a general reflection of the process, and
19
20
21 191 to reflect on both successful and unsuccessful processes of implementation. If it appeared, based on
22
23 192 the interview data, no attempt for implementation was performed, the interview data was not
24
25 193 included in the analyses. Interview data was analysed by summarizing information on residents' self-
26
27 194 perceived learning of CanMEDS competencies, assessing the learning effects of VBHC and gathering
28
29 195 detailed information on implementation facilitators and barriers. Individual interview data were
30
31 196 transformed into a transcript (MK) and clustered by two independent researchers (CN, SV) applying
32
33 197 the generally accepted principles of primary, secondary and tertiary coding to the data, in a constant
34
35 198 comparison, iterative approach. In case of disagreements discussion followed until consensus was
36
37 199 reached.
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44 201 **Results**

46 202 *Text-based summaries*

48 203 From the 63 VBHC projects identified in the publicly available online database (20), 56 VBHC projects
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50 204 were included and analysed (see figure 1). Fifty VBHC projects (89%) included in this study were
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52
53 205 implemented in practice.

55 206 - Insert figure 1 -
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208 In Table 2 a general description of the 56 included VBHC projects is presented. For 14 residents, the
 209 focus of their VBHC project was on more than one goal (e.g. medical education and medical care, or
 210 organisational efficiency and medical care).

211

212 *Individual semi-structured interviews*

213 Out of the 19 residents approached for the interview, 11 interviews were included and analysed in this
 214 study (see figure 2). To some extent (n= 5) residents and their projects were both included in the text
 215 based summaries and the interviews.

216 - Insert figure 2 -

217 Descriptive details of the VBHC projects conducted by the 11 residents interviewed are summarized in
 218 Table 2. Amongst others more detailed information can be found in Appendix 3.

219

220 *Table 2: Specifics of the included VBHC projects*

Method		Text-based summaries	Interviews
Setting	University medical centre	38 (68 %)	6 (55%)
	Non-academic	18 (32 %)	5 (45%)
Medical specialty	Anaesthesiology	4 (7 %)	2 (18%)
	Cardiology	1 (2%)	-
	Cardiothoracic surgery	2 (4 %)	-
	Clinical pharmacology	3 (5 %)	-
	Clinical genetics	3 (5 %)	-
	Internal medicine	1 (2 %)	-
	Neurology	1 (2 %)	2 (18%)
	Neurosurgery	4 (7 %)	1 (9%)
	Obstetrics and gynaecology	7 (13 %)	1 (9%)
	Orthopaedics	6 (11 %)	-
	Ophthalmology	2 (4 %)	-
	Paediatrics	1 (2%)	2 (18%)
	Plastic surgery	1 (2%)	-
	Psychiatry	3 (5 %)	1 (9%)
	Pulmonary medicine	3 (5 %)	-
	Radiology	4 (7 %)	-
	Rehabilitation medicine	1 (2 %)	2 (18%)
	Surgery	7 (13 %)	-
	Urology	1 (2 %)	-
Vascular medicine	1 (2 %)	-	
Focus of the projects	Organisational efficiency	14 (25 %)	-

Medical education	2 (4 %)	1 (9%)
Medical care	25 (45 %)	1 (9%)
More than one goal	14 (25 %)	9 (82%)

221

222 **CanMEDS competency development**

223 Data from the text-based summaries showed that self-perceived learning effects regarding CanMEDS
 224 roles were 100% for at least two competencies. In addition 93% of the residents trained three or more
 225 CanMEDS competencies when conducting a VBHC project. In frequency order, the highest trained
 226 competencies were 'leader' (n=50), 'communicator' (n=48), and 'collaborator' (n=48). See figure 3 for
 227 more details.

228 The interview data showed a similar distribution of self-perceived learning regarding CanMEDS
 229 roles (see Figure 3), except for the competency health advocate (n=11) and to some extent scholar
 230 (n=5). Supporting quotes were found for most frequent trained competencies: R3: *"I learned a lot
 231 about organisation of healthcare and how many possibilities there still are for improvement."* R1: *"[...]
 232 communication: by the high frequency of presentations I had to do; organisation as well, because I
 233 gained great insight in the structure of our organisation, financial background, whom different
 234 stakeholders are and how choices are made."* R4: *"I learned about health advocacy because I tried to
 235 reduce health care costs for the community without loss of quality of care."* R7: *"Collaborator: I learned
 236 that supportive departments, for example the financial administration, are easily reached which gave
 237 me great insight in how the organisational structure is, but also showed me that communications
 238 sometimes is lacking."* R10: *scholar, because I did a complete literature investigation to support the
 239 new protocol I implemented."*

240 - Insert figure 3 -

241

242 **Recognition of VBHC dilemmas in clinical practice**

243 Conducting VBHC projects included a step-by-step guidance and completion of the format. Doing this,
 244 the VBHC dilemma could be linked to clinical practice, facilitating the recognition of VBHC – or the

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3 245 lacking of - VBHC in practice. All text-based summaries of VBHC projects included in this study (N=56),
4
5 246 described the VBHC dilemma by defining the costs and outcomes from multiple perspectives and the
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7 247 goal for improvement or alternatives for practice (see appendix 1, item 2 and 3). The interviewed
8
9 248 residents (N=11) supported this finding since they could all explain how this format helped them to
10
11 249 recognize the VBHC dilemma. R12: *"the format obliges you to walk through the process step by step.*
12
13 250 *We often say we do, but this helps us actually do so, because you have an anchor."* Furthermore, the
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15 251 interview data yielded that residents were able to explain their learning regarding VBHC in clinical
16
17 252 practice as well. R10: *"[...] every randomised controlled trial we use or refer to in clinical practice that*
18
19 253 *refers to cost in relation to quality reflects a moment were we reflect on VBHC [...] we don't always*
20
21 254 *recognise it, but it is the basis of VBHC."* In addition, all interviewed residents (n=11) could explain the
22
23 255 multiple perspectives they took into account when analysing their VBHC problem. R5: *"I learned to*
24
25 256 *reduce waste and made the process of patient letters more efficient and improved the quality of care*
26
27 257 *in the same process. So, patient, doctor and organisation have a benefit."*
28
29 258 In addition, all interviewed residents (n=11) explained how they became more aware of the
30
31 259 relationship between both costs and effects (value), when conducting their VBHC project. For example,
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33 260 R8: *"we measured the number of no-shows in the intervention group versus the group that received*
34
35 261 *standard care, and measured the revenues we missed out on because of the no-shows."* R7: *"I reduced*
36
37 262 *costs without loss of quality of care for the patient by reducing standardised laboratory tests upon*
38
39 263 *admission."* Self-perceived learning effect could also be described as an improvement on awareness
40
41 264 and identification of costs in a broader perspective. R4: *"We had a reduction in leading time, for patient*
42
43 265 *letters to the general practitioner, from an average of a few weeks to at least 80% finished and send*
44
45 266 *within 5 days after discharge. But the cost reduction and quality improvement I envisioned were not*
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47 267 *just the reduction in leading time of the patient letter, but also in better care when the GP has adequate*
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49 268 *information as soon as possible."*
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Implementation facilitators and barriers

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3 271 Resident's (n=6) stated that detecting and defining the problem is a very important facilitator and
4
5 272 relates to the first step in the VBHC process: R4: *"A thorough investigation of the problem and making*
6
7 273 *sure we knew why and for whom the problem was relevant made implementation a lot easier"*. A much-
8
9
10 274 needed item to facilitate implementation (n=11) was the involvement and support from all
11
12 275 stakeholders defined during the second step in the guidance by experts: stakeholder analyses. R4:
13
14 276 *"Involve all relevant stakeholders and create a sense of urgency and relevance"*. R2: *"Everybody*
15
16 277 *(doctors, nurses, secretarial staff) recognised the problem of a language barrier and wanted a change*
17
18 278 *to be able to take better care of patients who speak a different language [...]"* Intrinsic motivation to
19
20 279 solve the problem was a huge facilitator as well for many residents (n=5). R8: *"[...] my interest and*
21
22 280 *motivation turned a small project into a hospital wide project."* A final facilitator many residents (n=7)
23
24 281 mentioned, was a mentor or supervisor who helped them with potential barriers, and that they
25
26 282 probably would not have been able to change anything without their support. R6: *"The educational*
27
28 283 *committee supported my project and supported the different residents to investigate and implement*
29
30 284 *possibilities. That was really helpful."*

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32
33
34 285 Self-perceived barriers were often the opposites of the facilitators related to the VBHC
35
36 286 dilemma. For example no clear VBHC dilemma or no clear problem definition. A major barrier for
37
38 287 implementation is felt to be in the preconditions and technical aspects, for instance ICT or secretarial
39
40 288 support to implement the VBHC project. R11: *"In the end, the ICT application was not realized and*
41
42 289 *therefore I could not implement my project."* Another barrier mentioned was the lack of a supportive
43
44 290 environment by a sufficient number of stakeholders involved (n=6). On the one hand, too few could
45
46 291 be experienced as a barrier. R10: *"in the end I did not have enough support from the other residents to*
47
48 292 *implement my change although the educational committee was on board."* On the other hand,
49
50 293 involvement of too many stakeholders was also described as a barrier. R11: *"I needed not only other*
51
52 294 *residents, but also different supervisors to be on-board with the plan, which I understood along the*
53
54 295 *way."* Finally, the extent of the project made it more difficult to implement, for instance when the
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296 whole organisation was involved instead of just your own department (n=3). R11: *“because it became*
297 *a hospital wide project, it is currently not yet implemented.”*

298

299 Discussion

300 In this explorative mixed-methods study different aspects of learning when conducting small,
301 pragmatic VBHC projects, from the residents’ perspective, were identified. Firstly, conducting VBHC
302 projects was shown to contribute to developing different CanMEDS competencies, especially
303 communicator, collaborator, leader and health advocate. Secondly, residents learned to recognise
304 VBHC dilemmas in clinical practice. Finally, facilitators for and barriers to implement VBHC projects
305 were explored. In the subsequent sections, these findings will be discussed more extensively.

306 Firstly, our study has shown that by conducting VBHC projects, residents were provided
307 opportunities to further develop at least two different CanMEDS competencies. Our data showed that
308 competencies ‘leader’, ‘collaborator’ and ‘communicator’ were most often learned. These are
309 examples of the ‘soft’ competencies. Helping master these competencies was part of the motivation
310 of stimulating our residents to perform VBHC projects. Also, the competencies ‘scholar’ and ‘health
311 advocate’ were mentioned, but especially by the participants of the interviews, more than in the text-
312 based summaries. This was an unexpected and remarkable finding: young medical specialists feel
313 inadequately prepared for these specific competencies (3).

314 Secondly, we showed that residents are facilitated to learn to recognize a VBHC dilemma in
315 clinical practice, when conducting a VBHC project. Additionally, they perceive an improvement on
316 awareness regarding VBHC. Our data supports that when residents conduct VBHC projects, recognition
317 of VBHC dilemmas in medical practice is facilitated if they: (i) perform a thorough investigation of the
318 problem, (ii) explore potential barriers and, (iii) set up a project viable for implementation. This data
319 might overestimate the learning effects because we only included those residents who believed their
320 projects were viable for implementation and those with the intrinsic motivation to make a change
321 since participation in VBHC projects was voluntary. For future research it could be interesting to

1
2
3 322 investigate if VBHC projects are fruitful learning opportunities when mandatory in any post-graduate
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5 323 curriculum.

6
7 324 Finally, the self-perceived facilitators for and barriers to implement a VBHC project during
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9
10 325 residency training were extracted from the interviews. The information found, showed many
11
12 326 similarities to the current literature on facilitators and barriers in change management (21-23). Based
13
14 327 on the modified model of Senge 1999 (21) and the model of Kotter 2002 (22) with key roles by O'Neill
15
16 328 2007 (23), the following potential facilitators were extracted. These are compared and interwoven
17
18 329 here as they are believed to be crucial when implementing a VBHC project successfully. First, a
19
20 330 thorough investigation of the VBHC dilemma, in terms of balancing costs and outcomes, from multiple
21
22 331 perspectives (such as patient, organisation, doctor, nurses, and supportive staff) is crucial to establish
23
24 332 a sense of urgency and/or relevance. This is much needed to get support from the people involved in
25
26 333 the (potential) change. Next, it is crucial to identify stakeholders and get them involved. This is only
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28 334 possible via 'a clear VBHC dilemma', of relevance for those to whom it's related. Then, find a supervisor
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30 335 or mentor with influence to make the change happening and someone who has control of resources,
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32 336 in a hospital this could also be several different people. Finally establish a plan of action, keep it small
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34 337 and simple, within your own influence, and describe how effects are going to be measured (i.e. in
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36 338 terms of costs and effects) from the start to prove improvement. In the end you need to consolidate
37
38 339 and secure your new way of working. Appendix 4 summarizes the tips for residents who want to
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40 340 implement a VBHC project. In the end, we would advise any educator who is about to support residents
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42 341 when implementing VBHC projects to: use a similar format and combine structured teaching with
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44 342 support by an expert in the field. This strategy adheres to the necessary requirements of knowledge,
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46 343 support, role models and reflection when it comes to teaching the concepts of VBHC (18)

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53 54 345 **Conclusion**

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57 346 This study revealed the positive impact of incorporating VBHC projects within the residency training
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59 347 program. VBHC-projects are resident-led and practice-based, and proved to be an effective

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3 348 educational method to learn and develop CanMEDS competencies and learn and practice the concepts
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5 349 of VBHC via learning-by-doing. Residents learn to recognise VBHC dilemmas, learn how to implement
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7 350 an effective change and have the potential to influence medical care, medical education or efficiency
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10 351 in health care. According to residents, important facilitators for successfully implementing a change
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12 352 are a thorough investigation of the VBHC dilemma combined with a thorough stakeholder analysis.
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Practice points:

- Introducing a societal relevant theme such as VBHC in residency training programs is a promising strategy to enhance competency-based education.
- Residents develop different CanMEDS competencies, especially those of 'leader', 'communicator' and 'collaborator' when conducting a VBHC project.
- Residents learn to recognize VBHC dilemmas in practice when combining formal teaching with conducting VBHC projects.
- A thorough investigation of a VBHC dilemma combined with an in-depth stakeholder analysis are key to successfully implementing a VBHC project.

354

355 **List of abbreviations**

356	CanMEDS	Canadian Medical Education Directives for Specialists
357	VBHC	Value-Based Healthcare

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359 **Figure legends**

360 *Figure 1: Flowchart on selection and exclusion of text-based summaries*

361 *Figure 2. Flowchart on selection and exclusion of individual semi-structured interviews*

362 *Figure 3: Self-perceived learning regarding the different CanMEDS competencies*

363

364 **Declarations**

365 *Author contributions :*

366 SV analyzed and interpreted all data and was a major contributor in writing the manuscript. CN
367 analyzed and interpreted data and was a major contributor in writing the manuscript. MK performed
368 the interviews and analyzed data. BE, IH, LS and WM contributed in writing the manuscript. All authors
369 read and approved the final manuscript.

370 *Competing interests:*

371 *The authors declare no competing interests*

372 *Funding:*

373 There was no funding for this research project.

374 *Data sharing statement:*

375 Project information is available via <https://www.oorzon.nl/doelmatigheidsinitiatieven-oor-zon>.

376 Besides this no additional data is available.

377 *Acknowledgments:*

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Figure 1: Flowchart on selection and exclusion of text-based summaries

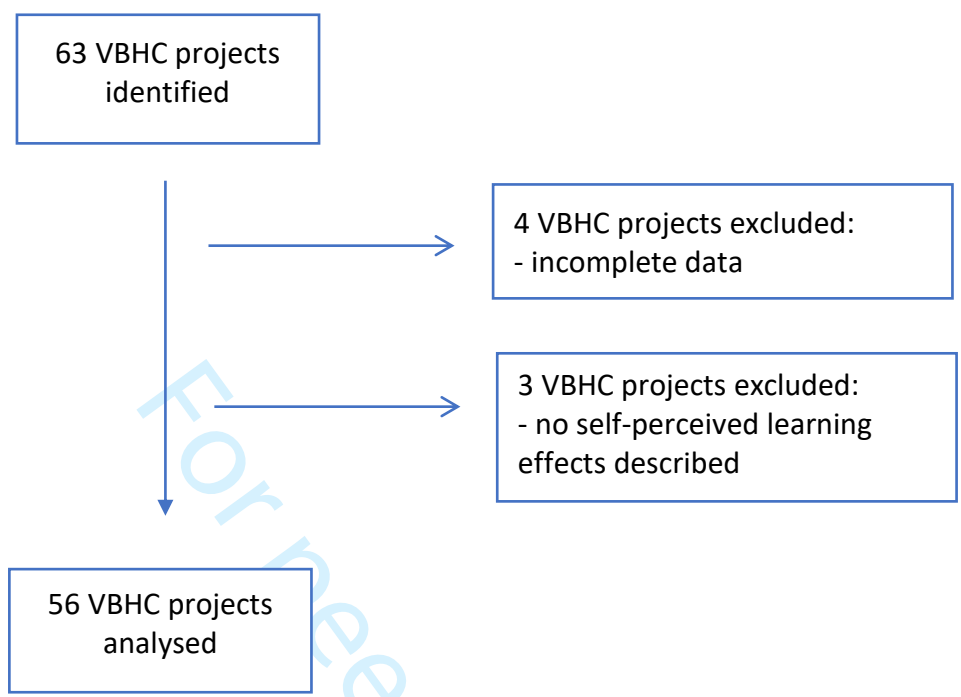


Figure 2. Flowchart on selection and exclusion of individual semi-structured interviews

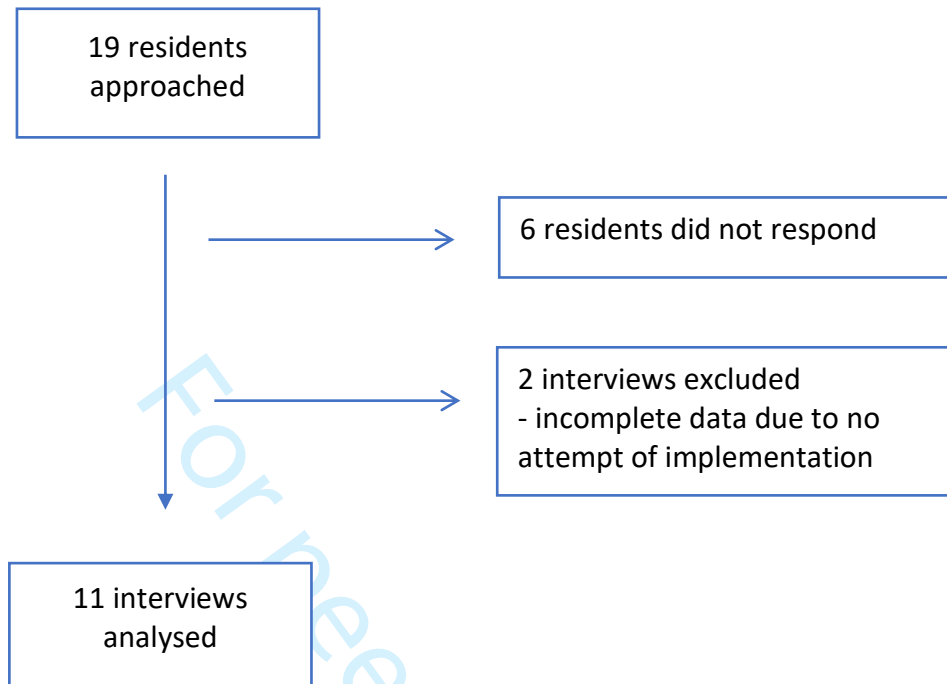
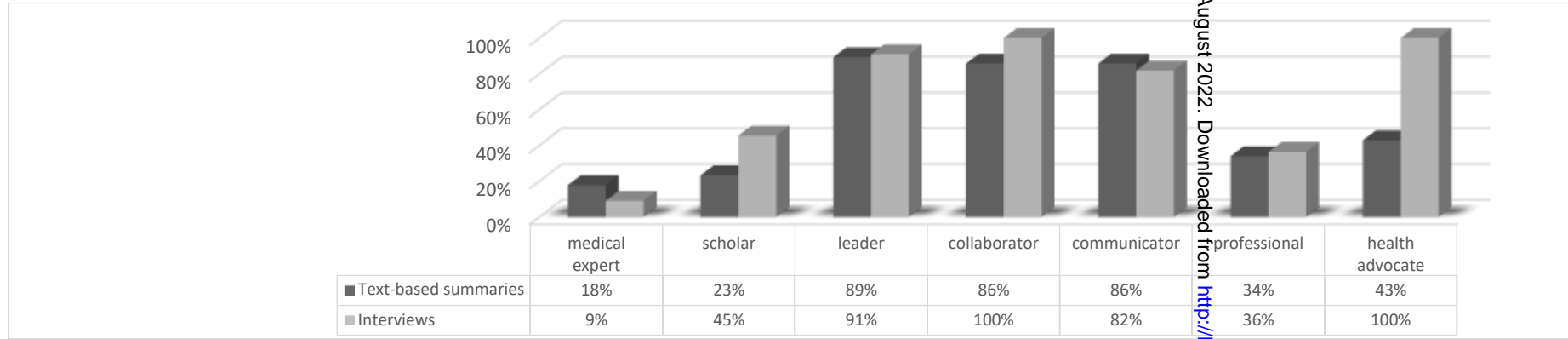


Figure 3: Self-perceived learning regarding the different CanMEDS competencies



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Appendix 1: Format VBHC projects (multiple 2019)

Format VBHC project <i>[title of project]</i>	
ABSTRACT (Max. 150 words)	
A) What does this project contribute to the improvement of the quality of care at your department or organisation?	
B) How are the general competencies (for example communicator, collaborator, leader, health advocate and professional) trained and evaluated by conducting and implementing this VBHC project?	
C) How will you secure this VBHC project within your organisation or at your department?	
1) Medical specialty:	
2) Issue:	<i>[describe with a max. of 150 words what the problem or issue is you would like to change with this project]</i>
3) Goal of the project:	<i>[describe what your main goal is]</i>
4) Plan of action:	<i>[describe your plan of action stepwise, max. 200 words. Describe the procedure and your plan of implementation. Explain both analysis and plan of action]</i>
5) Aimed results:	<i>[describe, max. 150 words, your aimed results of this VBHC project, in terms of costs and effects]</i>
6) Achieved results:	<i>[describe, max. 150 words, your results so far, in terms of costs and effects]</i>
7) Evaluation:	<i>[describe, max. 150 words, how you will evaluate the costs and effects of your VBHC project, in the long-term]</i>
8) Consolidate:	<i>[describe, max. 150 words, how you will institutionalize this project within the current structure of the organisation or department]</i>
9) Generalizability:	<i>[describe if your results might be applicable at other departments, organisations or regions]</i>
10) Role resident:	<i>[describe your role in this VBHC project]</i>
11) Learning effects:	<i>[describe what you learned by executing this project, how you learned this and how evaluated what you have learned]</i>
12) Mentor:	<i>[describe the role of the mentor / supervisor regarding the execution of the VBHC project]</i>

I agree this information will be published at the OORZON (Southeast region of Netherlands) website.

Appendix 2: Topic list for semi-structured interview

The topic list was constructed by two experienced researchers in this field, minor changes were made after a pilot interview.

VBHC- Projects	1) General information - Definition of VBHC & position in PGME - Goal of own VBHC project - Orientation (education, process, care delivery, ...)
	2) Implementation - Enhancing factors - Hindering factors
	3) Learning goals and learning curves - initial goal - achieved goal
	4) Self-perceived competency training - components trained & developed
	5) Self-perceived effect on influencing medical care - patient outcomes and experiences - costs (for example in monetary terms, efficiency, others)
	6) Embedding within organisation - reasons - enhancing or hindering factors

Appendix 3: Basic characteristics and focus of projects of the residents interviewed

	Specialty	Impl.*	Primary focus	Res.**	Explanation of exact focus
R1	Neurosurgery	Yes	Education	No	Development of a training session for other residents on registration and finances in their department
R2	Anesthesiology	Partly	Care and efficiency	No	ICT application to register any language barriers and provide helpful tools to overcome this language barrier
R3	Anesthesiology	Partly	Care and efficiency	No	ICT application to register any language barriers and provide helpful tools to overcome this language barrier
R4	Rehabilitation	Yes	Care and efficiency	No	Improving the leading time of patient letters
R5	Neurology	Yes	Care and efficiency	No	Implementation of digital patient letters to improve lead time
R6	Pediatrics	Yes	Care and efficiency	No	Give residents a day at another speciality to learn from each other and see possibilities to make work more efficient
R7	Rehabilitation	Yes	Care	Yes	Stop standard laboratory testing on admittance, only perform test when necessary
R8	Psychiatry	Yes	Care and efficiency	Yes	Send a standard SMS reminder before outpatient consults to reduce the number of no-shows
R9	Gynaecology	Yes	Care and efficiency	Yes	Direct removal of a catheter after a laparoscopic hysterectomy
R10	Pediatrics	No	Care and efficiency	No	Implementing a new structure for duty schedules to bring more continuity on the ward
R11	Neurology	No	Care and efficiency	No	ICT application to show when a patient had completed in hospital treatment and is waiting for a bed elsewhere

* Implemented at time of the interview.

** VBHC project was part of a research project or PhD trajectory

Appendix 4: Tips for residents' performing a VBHC project within a modified model of change

Examine the VBHC problem thoroughly

- *Complete assessment of the current situation from multiple perspectives (patient, doctor, organisation, etc)*
- *Take the culture of the organisation into account*

Establish a sense of urgency and/or relevance

Identify potential problems that could stand in the way of your change

- *Identify and involve all stakeholders*

Form a powerful coalition with enough power to lead the change

Different key roles:

- *Sponsor and/or advocate (can be a supervisor or mentor for instance)*
- *Implementer (often resident)*
- *Change agent (often resident)*

Create a vision and develop strategies for achieving that vision

- *keep it small and keep it simple, within your scope of power*

Communicate your vision

Plan for short-term wins

- *make sure you can show what is improved*

Consolidating improvement and still produces more change

- *implementation is more than changing a protocol. All employees involved need to work in the new way.*

Institutionalizing your change so it is incorporated in the new culture

- *make sure you can show what is improved to support the sense of urgency to stick to the new way of working*
 - *secure the new way of working in ways that are not solely depending on your presence*
-

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6-8
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	n.a.
Study size	10	Explain how the study size was arrived at	8,9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	n.a.
		(b) Describe any methods used to examine subgroups and interactions	n.a.
		(c) Explain how missing data were addressed	n.a.
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	

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60**Results**

Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8,9
		(b) Give reasons for non-participation at each stage	8,9
		(c) Consider use of a flow diagram	8,9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	n.a.
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	n.a.
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	n.a.
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	-
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	-
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-

Discussion

Key results	18	Summarise key results with reference to study objectives	13
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13,14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	13,14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14

Other information

Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16
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*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Incorporating Value-based Healthcare Projects in Residency Training: A mixed methods study on the impact of participation on understanding & competency development

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Keywords:	EDUCATION & TRAINING (see Medical Education & Training), HEALTH ECONOMICS, Change management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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Incorporating Value-based Healthcare Projects in Residency Training:

A mixed-methods study on the impact of participation on understanding & competency development

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Word count abstract: 298

Word count article: 3961

32 **Abstract**

33 **Objectives:** Stimulating the active participation of residents in projects with societally relevant
34 healthcare themes, such as Value-Based Healthcare (VBHC), can be a strategy to enhance competency
35 development. Canadian Medical Education Directions for Specialists (CanMEDS) competencies such as
36 leader and scholar are important skills for all doctors (1). In this study, we hypothesise that when
37 residents conduct a VBHC project, CanMEDS competencies are developed. There is the added value of
38 gaining knowledge about VBHC.

39 **Design:** An explorative mixed-methods study assessing residents' self-perceived learning effects of
40 conducting VBHC projects according to three main components: (i) CanMEDS competency
41 development, (ii) recognition of VBHC dilemmas in clinical practice, and (iii) potential facilitators for
42 and barriers to implementing a VBHC project. We triangulated data resulting from qualitative analyses
43 of: (a) text-based summaries of VBHC projects by residents and (b) semi-structured interviews with
44 residents who conducted these projects.

45 **Setting:** Academic and non-academic hospitals in the Netherlands.

46 **Participants:** Out of 63 text-based summaries from residents, 56 were selected, and out of 19 eligible
47 residents, 11 were selected for semi-structured interviews and were included in the final analysis.

48 **Results:** Regarding CanMEDS competency development, the competencies 'leader', 'communicator'
49 and 'collaborator' scored the highest. Opportunities to recognise VBHC dilemmas in practice were
50 mainly stimulated by analysing healthcare practices from different perspectives, and by learning how
51 to define costs and relate them to outcomes. Finally, implementation of VBHC projects is facilitated by
52 a thorough investigation of a VBHC dilemma combined with an in-depth stakeholder analysis.

53 **Conclusion:** In medical residency training programmes, competency development through active
54 participation in projects with societally relevant healthcare themes—such as VBHC—was found to be
55 a promising strategy. From a resident's perspective, combining a thorough investigation of the VBHC
56 dilemma with an in-depth stakeholder analysis is key to the successful implementation of a VBHC
57 project.

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7 59 **Strengths and limitations of this study**

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- 9 60 • The residents included were from diverse specialities, both academic and non-academic,
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- 10 61 making this research relevant for a broad spectrum of doctors and educators.
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- 12 62 • This is a practice-oriented study, easily applicable in current medical practice.
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- 14 63 • Data from the semi-structured interviews supported data from the text-based summaries,
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- 15 64 although the sample size is small.
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- 17 65 • CanMEDS competency development was self-reported.
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- 19 66 • Only projects that were thought to be viable for implementation and led by residents with the
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- 20 67 intrinsic motivation to make a change were publicised and therefore eligible for selection,
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- 21 68 which could lead to overestimation of the results.
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32 70 **Key words**

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48 76 **Background**49
50 77 The Canadian Medical Education Directions for Specialists (CanMEDS) project contributed to a major
51 78 change in medical education (undergraduate and postgraduate), moving away from a time-based
52 79 learning system to a competency-based learning system ([1](#)). It describes important competencies
53 80 residents should master during their training, such as communicator, collaborator, leader and health
54 81 advocate ([2](#), [3](#)). However, it appears that the `soft` competencies such as `leader` and `health advocate`
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4 82 are neither easy to teach nor to assess (4). Educational efforts that specifically train these
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6 83 competencies are therefore appreciated.

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8 84 In addition to the CanMEDS competencies, and to ensure that physicians' competencies align
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10 85 with evolving health systems, overarching themes focusing on societal needs and future demands are
11
12 86 increasingly integrated into medical education (5). Examples of such themes are patient safety, shared
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14 87 decision-making, and value-based health care (6-8). In the Netherlands, educators undertook action to
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16 88 combine these developments, resulting in the CanBetter project, which started in 2015 (8). That
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18 89 project involved linking the development of all CanMEDS competencies with teaching residents about
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20 90 societally relevant themes. Value-based healthcare (VBHC) is one of the current relevant themes the
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22 91 CanBetter project focusses on, because health care expenditure is rising and medical professionals
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24 92 need to take their responsibility for keeping costs down (9).

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28 93 VBHC is defined as the health outcome that matters to the patient, relative to the costs of
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30 94 achieving this outcome (9). Health outcomes can be, for example, disease-free survival for patients
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32 95 with cancer, or the time needed to regain functionality after a knee joint replacement (9). As well as
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34 96 achieving the health outcomes, the professionals are also responsible for the stewardship of resources,
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36 97 which requires an entirely new way of managing (10). Therefore, instruction, training and fundamental
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38 98 knowledge of VBHC are required (11-13). Past efforts to teach residents about cost-effective care have
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40 99 unfortunately not always been as effective as intended (14, 15), for example, because medical
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42 100 education didn't provide a positive culture, the training environment was not suitable, or difficulties
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44 101 arose when changing practice patterns of both residents and the supervising faculty (15).

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48 102 Recent research has illustrated that key elements of learning to deliver VBHC are knowledge
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50 103 transmission, appropriate role modelling, reflection, and the presence of a supportive environment
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52 104 (13). Medical students and residents must be educated and trained in settings where they have
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54 105 opportunities to develop and use VBHC, preferably a clinical setting (16-18). Amongst others, a specific
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56 106 training programme, incorporating formal and informal learning, is necessary to learn how to deliver
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58 107 VBHC (19). The residency training programmes are believed to be one of the best places to initiate
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4 108 VBHC education because residents are adaptable, highly educated and motivated. In addition, it has
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6 109 been shown that what residents learn during their residency has a significant impact on how they treat
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8 110 their patients when they become medical specialists (20).

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10 111 In our regional organisation of teaching hospitals, a strategy was set up that combined formal
11
12 112 and informal training within the residency training programme, getting residents involved with VBHC.
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14 113 Residents were stimulated to critically assess daily healthcare and recognise potential VBHC dilemmas
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16 114 and transform all this into a VBHC project. Such VBHC projects are resident-led and practice-based.

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18
19 115 This study evaluates the impact of incorporating VBHC projects within the residency training
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21 116 programme. The following research questions were formulated: (I) Which CanMEDS competencies do
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23 117 residents develop when conducting VBHC projects in residency training? (II) Is recognition of VBHC
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25 118 dilemmas in medical practice facilitated when residents conduct VBHC projects during their residency
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27 119 training programme? (III) Which facilitators for and barriers to VBHC project implementation can we
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29 120 detect when conducting a VBHC project during residency training?
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35 122 **Methods**

36 37 123 ***Study Design***

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39 124 An explorative mixed-methods design was used. The study entailed an analysis of retrospective
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41 125 information from text-based summaries of VBHC projects conducted by residents between 2014 and
42
43 126 2018, and semi-structured interviews with residents. The text-based summaries were retrieved via the
44
45 127 “standard format for VBHC projects” (see appendix 1 for the format), which are publicly available in
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47 128 Dutch via a webpage (21).
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53 130 ***Ethical approval***

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55 131 Ethical approval was provided by the Dutch Association for Medical Education (NVMO) on June 19,
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57 132 2017 (ID number 915).
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4 134 **Patient and public involvement**

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6 135 Unfortunately, there was no Patient and Public Involvement in this study. Patient involvement was not
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8 136 applicable as there were no patients involved.

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12 138 **Setting**

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14 139 This study focused on the postgraduate training setting (residency training) in the southeast region of
15
16 140 the Netherlands. *Table 1* presents a general overview of the Dutch medical undergraduate and
17
18 141 postgraduate training programmes. The region of study has chosen to apply a multifaceted approach
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20 142 of incorporating VBHC in residency training by having residents conduct small, pragmatic initiatives
21
22 143 called “VBHC projects”. At the time of the study, VBHC training and projects were not mandatory,
23
24 144 though greatly encouraged as a method for residents to learn about VBHC in different ways.

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29 146 *Table 1. Overview of general characteristics of the Dutch undergraduate and postgraduate training*
30
31 147 *programmes*

Name and structure	Duration	Qualification after graduation
Preclinical training (bachelor)	3 years	Bachelor of medicine
Clinical training (master)	3 years	Physician, M.D.
Resident not in training	Optional	-
Residency training or training for general practitioner	3 to 6 years	Medical specialist, general practitioner

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37 149 **The VBHC projects**

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39 150 Residents were stimulated to critically assess daily healthcare and recognise potential VBHC dilemmas
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41 151 in practice. These dilemmas entail a wide range of problems or possibilities for improvement that
42
43 152 residents would come across; for example, inefficiency in logistics, unnecessary costs spent on
44
45 153 diagnostics, or a new treatment with fewer complications. Residents were then guided step-by-step.
46
47 154 Firstly, they were offered the knowledge and skills to identify, measure and evaluate both costs and
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49 155 outcome. Secondly, they were encouraged to discuss VBHC dilemmas with the relevant stakeholders,
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51 156 consequently assessing the dilemma from multiple perspectives. These perspectives could be the

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4 157 patient's, the doctor's, other health care professionals' and/or that from the health care organisation
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6 158 as a whole. Thirdly, residents had to determine goals for improvement or search for an effective
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8 159 alternative for current clinical practice. Finally, they reported to each other how they implemented
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10 160 their change or planned to implement their change, what facilitators and barriers they foresaw or
11
12 161 encountered (potential or actual), and what they learned during the process. Altogether, this resulted
13
14 162 in a VBHC project. In order to enhance the chance of successfully conducting such a project, the
15
16 163 residents were encouraged to keep the projects relatively small-scale, i.e. with the goal to finish it
17
18 164 within 3 to 6 months.
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22 23 166 **Data collection and analyses**

24 167 *Data collection & Analyses of Text-Based Summaries*

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26 168 VBHC projects were included in this study when a standard format was completed and published online
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28 169 on the publicly available webpage (21), with a clear problem statement and potential costs and effects
29
30 170 identified as measured and valued from multiple perspectives (at least 2). If the data were incomplete,
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32 171 an email and one reminder email were sent to request the missing information. If the data remained
33
34 172 incomplete, the VBHC project was excluded.
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39 173 The final set of included VBHC projects was assessed by two independent researchers (CN, SV).
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41 174 Data extraction of these projects involved a summary of the setting, medical specialty, focus of the
42
43 175 project, anticipated and achieved results, and learning effects in terms of the residents' self-perceived
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45 176 CanMEDS competency development. Data extraction yielded a score for the learning effects. Any
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47 177 disagreements were resolved through discussion. The focus of the projects was categorised after an
48
49 178 inductive process as medical education, medical care and/or organisational efficiency. The medical
50
51 179 education category included projects that aimed to improve education for residents, either in terms
52
53 180 of practical skills or theoretical knowledge. The medical care category included projects that focused
54
55 181 on improvement in the current quality of care and/or direct reduction of healthcare costs. The
56
57 182 organisational efficiency category included projects that aimed to optimise processes in healthcare.
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183

184 *Data Collection & Analyses of Semi-structured Interviews*

185 Semi-structured interviews were held with residents who conducted a VBHC project and published it
186 in the publicly available online database ([21](#)). After the initial contact with a resident, a reminder
187 request was sent if there was no response. All interviews were performed by telephone or face-to-face
188 by one investigator (MK) under the supervision of a trained interviewer (CN). There was no prior
189 relationship between the interviewer and the interviewees before the start of the study. Prior to
190 performing the interviews, a series of pilot interviews was held to train the interviewer and assess the
191 quality and feasibility of the topic list. The final topic list for the semi-structured interviews can be
192 found in appendix 2. The residents were asked to provide a general reflection of the process, and to
193 reflect on both successful and unsuccessful processes of implementation. If it appeared that no
194 implementation attempt was made, based on the interview data, the interview data was not included
195 in the analyses. Individual interview data were recorded and transcribed verbatim (MK).

196 The data were analysed by summarising information on the residents' self-perceived learning
197 of CanMEDS competencies, assessing the learning effects of VBHC, and gathering detailed information
198 on implementation facilitators and barriers. Data was clustered by two independent researchers (CN,
199 SV) applying the generally accepted principles of primary, secondary, and tertiary coding, in a constant
200 comparison ([22](#)), iterative approach. Regarding potential facilitators for and barriers to
201 implementation, this means reading through the transcripts inductively to find patterns ([23](#), [24](#)).
202 Finally, all interview data were searched for these patterns. These steps were executed by two
203 researchers (SV, CN), and in case of disagreement, dialogue followed until consensus was reached.

204

205 **Results**

206 *Text-based summaries*

207 From the 63 VBHC projects identified in the publicly available online database (21), 56 VBHC projects
 208 were included and analysed (see figure 1). Fifty VBHC projects (89%) included in this study were
 209 implemented in practice.

210 - Insert figure 1 -

211
 212 In Table 2, a general description of the 56 included VBHC projects is presented. For 14 residents, the
 213 focus of their VBHC project was on more than one goal (e.g. medical education and medical care, or
 214 organisational efficiency and medical care).

216 *Individual semi-structured interviews*

217 Out of the 19 residents approached for the interview, 11 were included and analysed in this study (see
 218 figure 2). To some extent (n= 5), both the residents and their projects were included in the text-based
 219 summaries and the interviews.

220 - Insert figure 2 -

221
 222 Descriptive details of the VBHC projects conducted by the 11 residents interviewed are summarised in
 223 Table 2. More detailed information can be found in Appendix 3.

224
 225 *Table 2: Specifics of the VBHC projects included*

Method		Text-based summaries	Interviews
Setting	University medical centre	38 (68%)	6 (55%)
	Non-academic	18 (32%)	5 (45%)
Medical specialty	Anaesthesiology	4 (7%)	2 (18%)
	Cardiology	1 (2%)	-
	Cardiothoracic surgery	2 (4%)	-
	Clinical pharmacology	3 (5%)	-
	Clinical genetics	3 (5%)	-
	Internal medicine	1 (2%)	-
	Neurology	1 (2%)	2 (18%)
	Neurosurgery	4 (7%)	1 (9%)
	Obstetrics and gynaecology	7 (13%)	1 (9%)
	Orthopaedics	6 (11%)	-

	Ophthalmology	2 (4%)	-
	Paediatrics	1 (2%)	2 (18%)
	Plastic surgery	1 (2%)	-
	Psychiatry	3 (5%)	1 (9%)
	Pulmonary medicine	3 (5%)	-
	Radiology	4 (7%)	-
	Rehabilitation medicine	1 (2%)	2 (18%)
	Surgery	7 (13%)	-
	Urology	1 (2%)	-
	Vascular medicine	1 (2%)	-
Focus of the projects	Organisational efficiency	14 (25%)	-
	Medical education	2 (4%)	1 (9%)
	Medical care	25 (45%)	1 (9%)
	More than one goal	14 (25%)	9 (82%)

226

227 **CanMEDS competency development**

228 Data analysis of the text-based summaries and interviews revealed that self-perceived learning
 229 effects regarding CanMEDS roles were present for at least two competencies. See figure 3 for details
 230 and distribution and the text below for elaboration and illustrative quotes.

231

232 - Insert figure 3 -

233

234 Data from the text-based summaries showed that self-perceived learning effects regarding CanMEDS
 235 roles were evident in all respondents for at least two competencies. In addition, 93% of the residents
 236 trained three or more CanMEDS competencies when conducting a VBHC project. In order of frequency,
 237 the best trained competencies were 'leader' (n=50), 'communicator' (n=48) and 'collaborator' (n=48).

238 The interview data showed a similar distribution of self-perceived learning regarding CanMEDS
 239 roles to the data from the text-based summaries (see Figure 3), except for the health advocate
 240 competency (n=11) and, to some extent, scholar (n=5), which were more often developed according
 241 to the interviewed residents. Supporting quotes were found for the most frequently trained
 242 competencies. R10 comment on scholar: "because I did a complete literature investigation to support
 243 the new protocol I implemented." R3 comment on leader: "I learned a lot about the organisation of
 244 healthcare and how many possibilities there still are for improvement." R7 comment on collaborator:

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4 245 *"I learned that supportive departments, for example the financial administration, are easily accessed,*
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6 246 *which gave me great insight into the organisational structure, but also showed me that communication*
7
8 247 *is sometimes lacking."* R1 comment on communicator: *"[...] communication as well, by the high*
9
10 248 *frequency of presentations I had to do."* R1 comment on organisation: *"[...] because I gained great*
11
12 249 *insight into the structure of our organisation, financial background, who different stakeholders are,*
13
14 250 *and how choices are made."* R4 comment on health advocate: *"I learned about health advocacy*
15
16 251 *because I tried to reduce health care costs for the community without loss of quality of care."*
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21 253 ***Learning concepts of VBHC***

23 254 Concerning the concepts of VBHC, our data revealed a few important aspects of the residents' learning
24
25 255 process. Firstly, the resident needs to recognise the VBHC dilemma in clinical practice. Next, they need
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27 256 to examine this dilemma from multiple perspectives. Finally, they need to balance costs versus
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29 257 outcome regarding this dilemma from these multiple perspectives.
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34 259 ***Recognition of VBHC dilemmas in clinical practice***

36 260 Conducting VBHC projects included a step-by-step guidance and completion of the format. This
37
38 261 allowed the VBHC dilemma to be linked to clinical practice, facilitating the recognition of VBHC - or its
39
40 262 lack - in practice. All text-based summaries of VBHC projects included in this study (N=56) described
41
42 263 the VBHC dilemma by defining the costs and outcomes from multiple perspectives and the goal for
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44 264 improvement or alternatives for practice (see appendix 1, items 2 and 3). The interviewed residents
45
46 265 (N=11) helped us to gain insight since they could explain how this format helped them to recognise the
47
48 266 VBHC dilemma. R12: *"the format obliges you to walk through the process step by step. We often say*
49
50 267 *we do, but this helps us actually to do so, because you have an anchor."*
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54 269 ***Learning multiple perspectives concerning VBHC***

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4 270 All interviewed residents (n=11) could explain the multiple perspectives they took into account when
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6 271 analysing their VBHC problem. R5: *"I learned to reduce waste and made the process of patient letters*
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8 272 *more efficient and improved the quality of care in the same process. So, patient, doctor and*
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10 273 *organisation benefit."*

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13 14 275 *Learning process of costs versus effects*

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17 276 All interviewed residents (n=11) explained how they became more aware of the relationship between
18
19 277 both costs and effects (value) when conducting their VBHC project. For example, R8: *"we measured*
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21 278 *the number of no-shows in the intervention group versus the group that received standard care, and*
22
23 279 *measured the revenues we missed out on because of the no-shows."* R7: *"I reduced costs without loss*
24
25 280 *of quality of care for the patient by reducing standardised laboratory tests upon admission."* A self-
26
27 281 perceived learning effect could also be described as an improvement in awareness and identification
28
29 282 of costs in a broader perspective. R4: *"We had a reduction in leading time for patient letters to the*
30
31 283 *general practitioner, from an average of a few weeks to at least 80% finished and sent within 5 days*
32
33 284 *after discharge. But the cost reduction and quality improvement I envisioned were not just the*
34
35 285 *reduction in leading time of the patient letter, but also in better care when the GP has adequate*
36
37 286 *information as soon as possible."* The interview data also revealed that the residents were able to
38
39 287 explain their learning regarding VBHC in clinical practice as well. R10: *"[...] every randomised controlled*
40
41 288 *trial we use or refer to in clinical practice that refers to cost in relation to quality reflects a moment*
42
43 289 *where we reflect on VBHC [...] we don't always recognise it, but it is the basis of VBHC."*

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49 50 291 **Facilitators for implementation**

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52 292 Residents mentioned a number of facilitators for implementation, in part related to the step-by-step
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54 293 process we use (see methods section for details). Firstly, a thorough problem analysis from multiple
55
56 294 perspectives is important. Secondly, the involvement of all important stakeholders seems essential.

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4 295 Thirdly, an intrinsic motivation to resolve the problem at hand is a strong facilitator. Finally, support
5
6 296 from a supervisor or mentor seems important.
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10 298 *Problem analysis*

11
12 299 Residents (n=6) stated that detecting and defining the problem is a very important facilitator and
13
14 300 relates to the first step in the process of conducting a VBHC project (see appendix 1, points 2, 3), in
15
16 301 which residents are stimulated to critically assess daily healthcare and recognise potential VBHC
17
18 302 dilemmas and assess all this from multiple perspectives. R4: *“A thorough investigation of the problem*
19
20 303 *and making sure we knew why and for whom the problem was relevant made implementation a lot*
21
22 304 *easier.”*
23

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25
26 306 *Stakeholder involvement*

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28 307 An important item to facilitate implementation (n=11) turned out to be the involvement and support
29
30 308 of all stakeholders as defined during the second step in the guidance by experts: stakeholder analyses.
31
32 309 R4: *“Involve all relevant stakeholders and create a sense of urgency and relevance”*. R2: *“Everybody*
33
34 310 *(doctors, nurses, secretarial staff) recognised the problem of a language barrier and wanted a change*
35
36 311 *to be able to take better care of patients who speak a different language [...].”*
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41 314 *Intrinsic motivation*

42
43 315 Intrinsic motivation to solve the problem was a huge facilitator as well for many residents (n=5). R8:
44
45 316 *“[...] my interest and motivation turned a small project into a hospital-wide project.”*
46
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49
50 319 *Support*

51
52 320 A final facilitator many residents (n=7) mentioned was a mentor or supervisor who helped them with
53
54 321 potential barriers, and that they probably would not have been able to change anything without their
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4 320 support. R6: *"The educational committee supported my project and supported the different residents*
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6 321 *to investigate and implement possibilities. That was really helpful."*

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10 323 ***Barriers to implementation***

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12 324 Self-perceived barriers were often the opposite of the facilitators related to the VBHC dilemma. For
13
14 325 example, there was no clear VBHC dilemma or no clear problem definition. A few distinct barriers were
15
16 326 mentioned, namely a lack of support, involvement of too many stakeholders, and problems with the
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18 327 magnitude of the project.

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24 329 ***Support***

25
26 330 A major barrier for implementation was felt to involve the preconditions and technical aspects, for
27
28 331 instance, ICT or secretarial support to implement the VBHC project. R11: *"In the end, the ICT application*
29
30 332 *was not realised and therefore I could not implement my project."* Another barrier mentioned was the
31
32 333 lack of a supportive environment by a sufficient number of the stakeholders involved (n=6). Too few
33
34 334 could also be experienced as a barrier. R10: *"in the end I did not have enough support from the other*
35
36 335 *residents to implement my change although the educational committee was on board."*

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41 337 ***Stakeholders***

42
43 338 Involvement of too many stakeholders was described as a barrier. R11: *"I needed not only other*
44
45 339 *residents, but also different supervisors to be on-board with the plan, which I understood along the*
46
47 340 *way."*

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51
52 342 ***Magnitude***

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54 343 Finally, the extent of the project made it more difficult to implement, for instance when the whole
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56 344 organisation was involved instead of just their own department (n=3). R11: *"because it became a*
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58 345 *hospital-wide project, it is currently still not implemented."*

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346 347 **Discussion**

348 In this explorative mixed-methods study, different aspects of learning were identified from the
349 residents' perspective when conducting small, pragmatic VBHC projects. Firstly, conducting VBHC
350 projects was shown to contribute to developing different CanMEDS competencies, especially
351 communicator, collaborator, leader and health advocate. Secondly, residents learned to recognise
352 VBHC dilemmas in clinical practice. Finally, facilitators for and barriers to implementing VBHC
353 projects were explored. In the subsequent sections, these findings will be discussed more
354 extensively.

355 Our study has shown that by conducting VBHC projects, residents were provided with
356 opportunities to further develop at least two different CanMEDS competencies. Our data showed that
357 the 'leader', 'collaborator' and 'communicator' competencies were most often developed. These are
358 examples of the 'soft' competencies (25). Mastering these competencies is helpful when implementing
359 any change project, and this motivates residents to acquire them (26). In this study, the 'scholar' and
360 'health advocate' competencies were often mentioned, especially by the participants of the
361 interviews, more than in the text-based summaries. This was an unexpected and remarkable finding:
362 young medical specialists feel inadequately prepared for these specific competencies (4).

363 We showed that residents are facilitated to learn to recognise a VBHC dilemma in clinical
364 practice when conducting a VBHC project. Additionally, they perceived an improvement in awareness
365 regarding VBHC, which is an important step in teaching residents to deliver VBHC (27). Our data
366 supports that when residents conduct VBHC projects, recognition of VBHC dilemmas in medical
367 practice is facilitated if they: (i) perform a thorough investigation of the problem, (ii) explore potential
368 barriers and (iii) set up a viable project for implementation. The data might overestimate the learning
369 effects because we only included those residents who believed their projects were viable for
370 implementation and those with the intrinsic motivation to make a change since participation in the
371 VBHC projects was voluntary. Intrinsic motivation has a known positive effect on change projects in

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3 372 health care (28). For future research, it could be interesting to investigate if VBHC projects are fruitful
4
5 373 learning opportunities when mandatory in any postgraduate curriculum.

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8 374 Finally, the self-perceived facilitators for and barriers to implementing a VBHC project during
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10 375 residency training were extracted from the interviews. We believe them to be crucial for the successful
11
12 376 implementation of a VBHC project. The information revealed many similarities to the contemporary
13
14 377 literature on facilitators and barriers in change management (29-31). First, a thorough investigation of
15
16 378 the problem is crucial (31), specifically concerning the VBHC dilemma. This means investigating the
17
18 379 costs and outcomes from multiple perspectives (such as patient, organisation, doctor, nurses, and
19
20 380 supportive staff) and balancing these costs versus outcomes (32). This is crucial in our opinion to
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22 381 establish a sense of urgency and/or relevance, which in turn is essential for a successful
23
24 382 implementation (33, 34). Next, it is important to identify stakeholders and get them involved (35, 36).
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26 383 This is only possible via 'a clear VBHC dilemma', of relevance for those who are affected by it (34).
27
28 384 Subsequently, find a supervisor or mentor with enough influence to make the change happen and
29
30 385 someone who has control of resources; in a hospital, this could be several different people (29). Then
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32 386 establish a plan of action, keep it small and simple, within your own scope of influence (37). Finally,
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34 387 describe how the effects are going to be measured (i.e. in terms of costs and effects) and demonstrate
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36 388 intermediate results (36). Ultimately, you need to consolidate and secure your new way of working
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38 389 (29). Inspired by the work of other researchers in the field of change management (29-31), we
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40 390 summarised the tips from this study in an overview checklist (see appendix 4). We hope to inspire and
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42 391 guide residents who want to implement a VBHC project. We would advise any educator who is about
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44 392 to support residents when implementing VBHC projects to use a similar format and combine structured
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46 393 teaching with support by an expert in the field (19). This strategy adheres to the necessary
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48 394 requirements of knowledge, support, role models and reflection when it comes to teaching the
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50 395 concepts of VBHC (19).
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397 **Conclusion**

398 This study revealed the positive impact of incorporating VBHC projects within the residency training
399 programme. VBHC projects are resident-led and practice-based, and proved to be an effective
400 educational method to learn and develop CanMEDS competencies and practise the concepts of VBHC
401 via learning-by-doing. Residents learn to recognise VBHC dilemmas, how to implement an effective
402 change and that they have the potential to influence medical care, medical education or efficiency in
403 health care. According to the residents, important facilitators for successfully implementing a change
404 are a thorough investigation of the VBHC dilemma combined with a thorough stakeholder analysis.

Practice points:

- Introducing a societally relevant theme such as VBHC in residency training programmes is a promising strategy to enhance competency-based education.
- Residents develop different CanMEDS competencies when conducting a VBHC project, especially those of 'leader', 'communicator' and 'collaborator'.
- Residents learn to recognise VBHC dilemmas in practice when combining formal teaching with conducting VBHC projects.
- A thorough investigation of a VBHC dilemma combined with an in-depth stakeholder analysis are key to successfully implementing a VBHC project.

406

407 **List of abbreviations**

408	CanMEDS	Canadian Medical Education Directives for Specialists
409	VBHC	Value-Based Healthcare

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411 **Figure legends**

412 *Figure 1: Flowchart on selection and exclusion of text-based summaries*

413 *Figure 2. Flowchart on selection and exclusion of individual semi-structured interviews*

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4 414 *Figure 3: Self-perceived learning regarding the different CanMEDS competencies*

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9 416 **Declarations**

10
11 417 *Author contributions :*

12
13 418 SV analysed and interpreted all data and was a major contributor in writing the manuscript. CN
14
15 419 analysed and interpreted data and was a major contributor in writing the manuscript. MK performed
16
17 420 the interviews and analysed data. BE, IH, LS and WM contributed to writing the manuscript. All authors
18
19 421 read and approved the final manuscript.

20
21
22 422 *Competing interests:*

23
24 423 *The authors declare no competing interests*

25
26 424 *Funding:*

27
28 425 There was no funding for this research project.

29
30 426 *Data sharing statement:*

31
32 427 Project information is available via <https://www.oorzon.nl/doelmatigheidsinitiatieven-oor-zon>. No
33
34 428 additional data is available.

35
36 429 *Acknowledgments:*

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45 433 **References**

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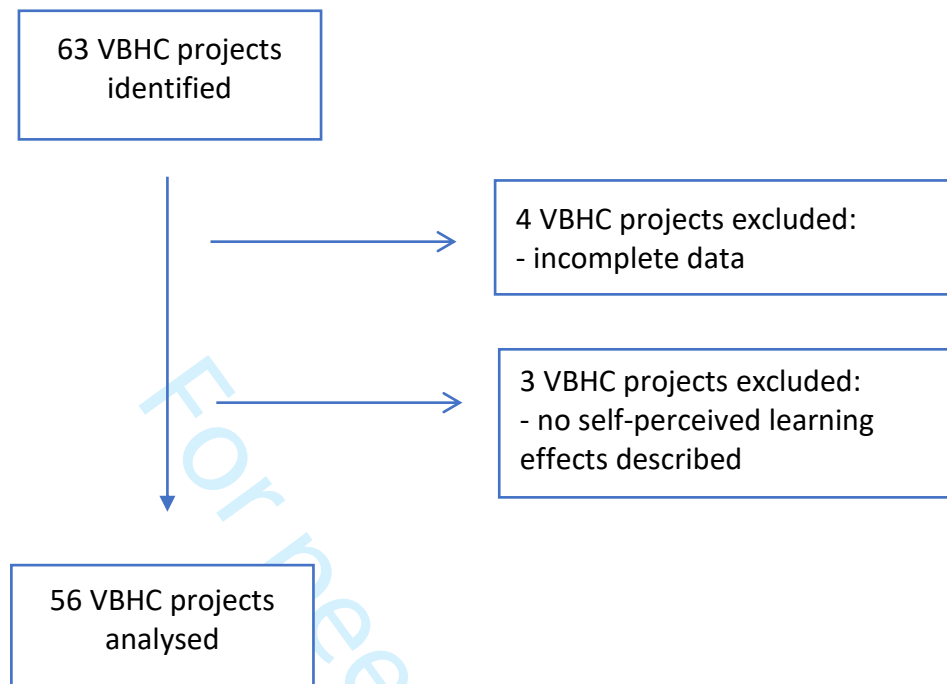
Figure 1: *Flowchart on selection and exclusion of text-based summaries*

Figure 2. Flowchart on selection and exclusion of individual semi-structured interviews

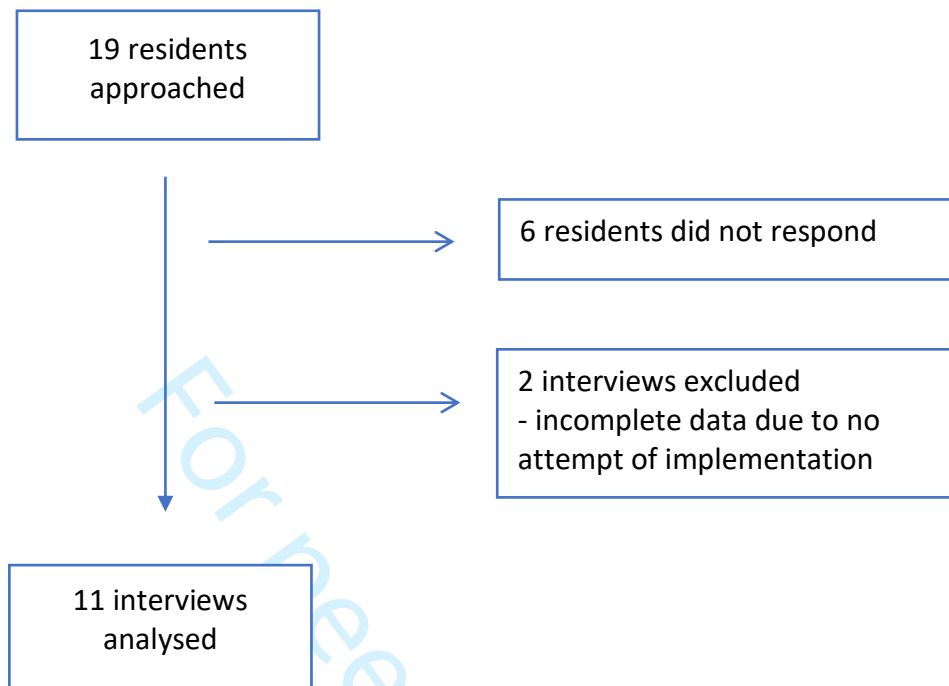
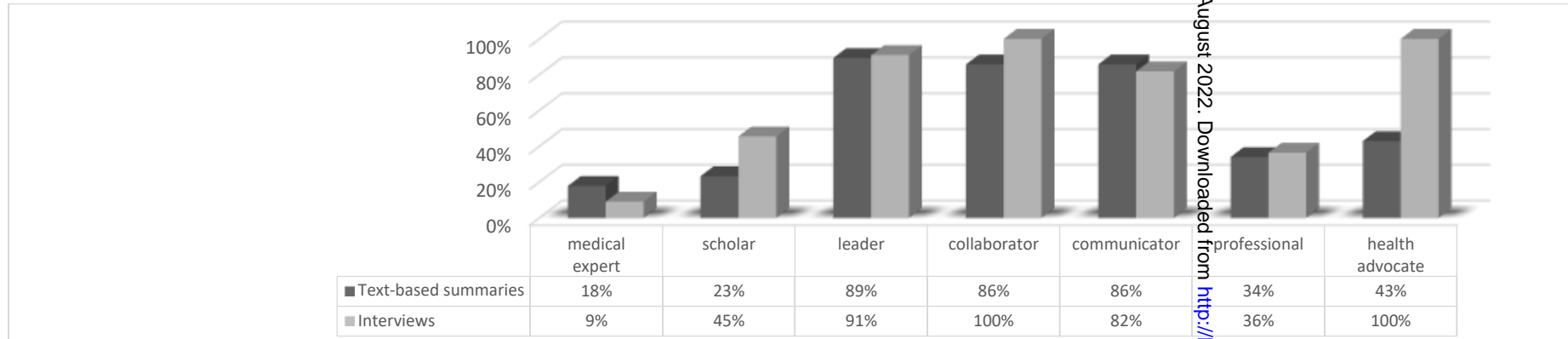


Figure 3: Self-perceived learning regarding the different CanMEDS competencies



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Appendix 1: Format VBHC projects (multiple 2019)

Format VBHC project <i>[title of project]</i>	
ABSTRACT (Max. 150 words)	
A) What does this project contribute to the improvement of the quality of care at your department or organisation?	
B) How are the general competencies (for example communicator, collaborator, leader, health advocate and professional) trained and evaluated by conducting and implementing this VBHC project?	
C) How will you secure this VBHC project within your organisation or at your department?	
1) Medical specialty:	
2) Issue:	<i>[describe with a max. of 150 words what the problem or issue is you would like to change with this project]</i>
3) Goal of the project:	<i>[describe what your main goal is]</i>
4) Plan of action:	<i>[describe your plan of action stepwise, max. 200 words. Describe the procedure and your plan of implementation. Explain both analysis and plan of action]</i>
5) Aimed results:	<i>[describe, max. 150 words, your aimed results of this VBHC project, in terms of costs and effects]</i>
6) Achieved results:	<i>[describe, max. 150 words, your results so far, in terms of costs and effects]</i>
7) Evaluation:	<i>[describe, max. 150 words, how you will evaluate the costs and effects of your VBHC project, in the long-term]</i>
8) Consolidate:	<i>[describe, max. 150 words, how you will institutionalize this project within the current structure of the organisation or department]</i>
9) Generalizability:	<i>[describe if your results might be applicable at other departments, organisations or regions]</i>
10) Role resident:	<i>[describe your role in this VBHC project]</i>
11) Learning effects:	<i>[describe what you learned by executing this project, how you learned this and how evaluated what you have learned]</i>
12) Mentor:	<i>[describe the role of the mentor / supervisor regarding the execution of the VBHC project]</i>

I agree this information will be published at the OORZON (Southeast region of Netherlands) website.

Appendix 2: Topic list for semi-structured interview

The topic list was constructed by two experienced researchers in this field, minor changes were made after a pilot interview.

VBHC- Projects	1) General information - Definition of VBHC & position in PGME - Goal of own VBHC project - Orientation (education, process, care delivery, ...)
	2) Implementation - Enhancing factors - Hindering factors
	3) Learning goals and learning curves - initial goal - achieved goal
	4) Self-perceived competency training - components trained & developed
	5) Self-perceived effect on influencing medical care - patient outcomes and experiences - costs (for example in monetary terms, efficiency, others)
	6) Embedding within organisation - reasons - enhancing or hindering factors

Appendix 3: Basic characteristics and focus of projects of the residents interviewed

	Specialty	Impl.*	Primary focus	Res.**	Explanation of exact focus
R1	Neurosurgery	Yes	Education	No	Development of a training session for other residents on registration and finances in their department
R2	Anesthesiology	Partly	Care and efficiency	No	ICT application to register any language barriers and provide helpful tools to overcome this language barrier
R3	Anesthesiology	Partly	Care and efficiency	No	ICT application to register any language barriers and provide helpful tools to overcome this language barrier
R4	Rehabilitation	Yes	Care and efficiency	No	Improving the leading time of patient letters
R5	Neurology	Yes	Care and efficiency	No	Implementation of digital patient letters to improve lead time
R6	Pediatrics	Yes	Care and efficiency	No	Give residents a day at another speciality to learn from each other and see possibilities to make work more efficient
R7	Rehabilitation	Yes	Care	Yes	Stop standard laboratory testing on admittance, only perform test when necessary
R8	Psychiatry	Yes	Care and efficiency	Yes	Send a standard SMS reminder before outpatient consults to reduce the number of no-shows
R9	Gynaecology	Yes	Care and efficiency	Yes	Direct removal of a catheter after a laparoscopic hysterectomy
R10	Pediatrics	No	Care and efficiency	No	Implementing a new structure for duty schedules to bring more continuity on the ward
R11	Neurology	No	Care and efficiency	No	ICT application to show when a patient had completed in hospital treatment and is waiting for a bed elsewhere

* Implemented at time of the interview.

** VBHC project was part of a research project or PhD trajectory

Appendix 4: Tips for residents' performing a VBHC project within a modified model of change

Examine the VBHC problem thoroughly

- *Complete assessment of the current situation from multiple perspectives (patient, doctor, organisation, etc)*
- *Take the culture of the organisation into account*

Establish a sense of urgency and/or relevance

Identify potential problems that could stand in the way of your change

- *Identify and involve all stakeholders*

Form a powerful coalition with enough power to lead the change

Different key roles:

- *Sponsor and/or advocate (can be a supervisor or mentor for instance)*
- *Implementer (often resident)*
- *Change agent (often resident)*

Create a vision and develop strategies for achieving that vision

- *keep it small and keep it simple, within your scope of power*

Communicate your vision

Plan for short-term wins

- *make sure you can show what is improved*

Consolidating improvement and still produces more change

- *implementation is more than changing a protocol. All employees involved need to work in the new way.*

Institutionalizing your change so it is incorporated in the new culture

- *make sure you can show what is improved to support the sense of urgency to stick to the new way of working*
 - *secure the new way of working in ways that are not solely depending on your presence*
-

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6-8
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	n.a.
Study size	10	Explain how the study size was arrived at	8,9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	n.a.
		(b) Describe any methods used to examine subgroups and interactions	n.a.
		(c) Explain how missing data were addressed	n.a.
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8,9
		(b) Give reasons for non-participation at each stage	8,9
		(c) Consider use of a flow diagram	8,9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	n.a.
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	n.a.
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	n.a.
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	-
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	-
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15, 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15,6
Generalisability	21	Discuss the generalisability (external validity) of the study results	15- 17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	n.a.

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.

BMJ Open

Incorporating value-based healthcare projects in residency training: a mixed-methods study on the impact of participation on understanding and competency development

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Secondary Subject Heading:	Health economics, Medical education and training, Medical management, Qualitative research
Keywords:	EDUCATION & TRAINING (see Medical Education & Training), HEALTH ECONOMICS, Change management < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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4 1 **Incorporating value-based healthcare projects in residency training: a mixed-**
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6 2 **methods study on the impact of participation on understanding and**
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8 3 **competency development**
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30 Word count abstract: 299

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32 **Abstract**

33 **Objectives:** Stimulating the active participation of residents in projects with societally relevant
34 healthcare themes, such as Value-Based Healthcare (VBHC), can be a strategy to enhance competency
35 development. Canadian Medical Education Directions for Specialists (CanMEDS) competencies such as
36 leader and scholar are important skills for all doctors. In this study, we hypothesise that when residents
37 conduct a VBHC project, CanMEDS competencies are developed. There is the added value of gaining
38 knowledge about VBHC.

39 **Design:** An explorative mixed-methods study assessing residents' self-perceived learning effects of
40 conducting VBHC projects according to three main components: (i) CanMEDS competency
41 development, (ii) recognition of VBHC dilemmas in clinical practice, and (iii) potential facilitators for
42 and barriers to implementing a VBHC project. We triangulated data resulting from qualitative analyses
43 of: (a) text-based summaries of VBHC projects by residents and (b) semi-structured interviews with
44 residents who conducted these projects.

45 **Setting:** Academic and non-academic hospitals in the Netherlands.

46 **Participants:** Out of 63 text-based summaries from residents, 56 were selected, and out of 19 eligible
47 residents, 11 were selected for semi-structured interviews and were included in the final analysis.

48 **Results:** Regarding CanMEDS competency development, the competencies 'leader', 'communicator'
49 and 'collaborator' scored the highest. Opportunities to recognise VBHC dilemmas in practice were
50 mainly stimulated by analysing healthcare practices from different perspectives, and by learning how
51 to define costs and relate them to outcomes. Finally, implementation of VBHC projects is facilitated by
52 a thorough investigation of a VBHC dilemma combined with an in-depth stakeholder analysis.

53 **Conclusion:** In medical residency training programmes, competency development through active
54 participation in projects with societally relevant healthcare themes—such as VBHC—was found to be
55 a promising strategy. From a resident's perspective, combining a thorough investigation of the VBHC
56 dilemma with an in-depth stakeholder analysis is key to the successful implementation of a VBHC
57 project.

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59 **Strengths and limitations of this study**

- 60 • The residents included were from diverse specialities, both academic and non-academic,
61 making this research relevant for a broad spectrum of doctors and educators.
- 62 • This is a practice-oriented study, easily applicable in current medical practice.
- 63 • Data from the semi-structured interviews supported data from the text-based summaries,
64 although the sample size is small.
- 65 • CanMEDS competency development was self-reported.
- 66 • Only projects that were thought to be viable for implementation and led by residents with the
67 intrinsic motivation to make a change were publicised and therefore eligible for selection,
68 which could lead to overestimation in the results.

69

70 **Keywords**

71 Value-Based Healthcare, Residency training programmes, Competency-based education, CanMEDS
72 competencies

73

74 **Introduction**

75 The Canadian Medical Education Directions for Specialists (CanMEDS) project contributed to a major
76 change in medical education (undergraduate and postgraduate), moving away from a time-based
77 learning system to a competency-based learning system (1). It describes important competencies
78 residents should master during their training, such as communicator, collaborator, leader and health
79 advocate (2, 3). However, it appears that the `soft` competencies such as `leader` and `health advocate`
80 are neither easy to teach nor to assess (4). Educational efforts that specifically train these
81 competencies are therefore appreciated.

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4 82 In addition to the CanMEDS competencies, and to ensure that physicians' competencies align
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6 83 with evolving health systems, overarching themes focusing on societal needs and future demands are
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8 84 increasingly integrated into medical education (5). Examples of such themes are patient safety, shared
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10 85 decision-making, and value-based health care (6-8). In the Netherlands, educators undertook action to
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12 86 combine these developments, resulting in the CanBetter project, which started in 2015 (8). That
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14 87 project involved linking the development of all CanMEDS competencies with teaching residents about
15
16 88 societally relevant themes. Value-based healthcare (VBHC) is one of the current relevant themes the
17
18 89 CanBetter project focusses on, because health care expenditure is rising and medical professionals
19
20 90 need to take their responsibility for keeping costs down (9).

21
22
23 91 VBHC is defined as the health outcome that matters to the patient, relative to the costs of
24
25 92 achieving this outcome (9). Health outcomes can be, for example, disease-free survival for patients
26
27 93 with cancer, or the time needed to regain functionality after a knee joint replacement (9). As well as
28
29 94 achieving the health outcomes, the professionals are also responsible for the stewardship of resources,
30
31 95 which requires an entirely new way of managing (10). Therefore, instruction, training and fundamental
32
33 96 knowledge of VBHC are required (11-13). As recent research had illustrated, past efforts to teach
34
35 97 residents about cost-effective care have unfortunately not always been as effective as intended (13-
36
37 98 15), and that key elements of learning to deliver VBHC are knowledge transmission, appropriate role
38
39 99 modelling, reflection, and the presence of a supportive environment (13). Medical students and
40
41 100 residents must be educated and trained in settings where they have opportunities to develop and use
42
43 101 VBHC, preferably a clinical setting (16-18). Amongst others, a specific training programme,
44
45 102 incorporating formal and informal learning, is necessary to learn how to deliver VBHC (19). The
46
47 103 residency training programmes are believed to be one of the best places to initiate VBHC education
48
49 104 because residents are adaptable, highly educated and motivated. In addition, it has been shown that
50
51 105 what residents learn during their residency has a significant impact on how they treat their patients
52
53 106 when they become medical specialists (20).

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4 107 In our regional organisation of teaching hospitals, a strategy was set up that combined formal
5
6 108 and informal training within the residency training programme, getting residents involved with VBHC.
7
8 109 Residents were stimulated to critically assess daily healthcare and recognise potential VBHC dilemmas
9
10 110 and transform all this into a VBHC project. Such VBHC projects are resident-led and practice-based.

11
12 111 This study evaluates the impact of incorporating VBHC projects within the residency training
13
14 112 programme. The following research questions were formulated: (I) Which CanMEDS competencies do
15
16 113 residents develop when conducting VBHC projects in residency training? (II) Is recognition of VBHC
17
18 114 dilemmas in medical practice facilitated when residents conduct VBHC projects during their residency
19
20 115 training programme? (III) Which facilitators for and barriers to VBHC project implementation can we
21
22 116 detect when conducting a VBHC project during residency training?
23
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27

28 118 **Methods**

29 119 ***Study design***

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31
32 120 An explorative mixed-methods design was used. The study entailed an analysis of retrospective
33
34 121 information from text-based summaries of VBHC projects conducted by residents between 2014 and
35
36 122 2018, an analysis of semi-structured interviews with residents and a comparison of data of both
37
38 123 analyses. The text-based summaries were retrieved via the “standard format for VBHC projects” (see
39
40 124 appendix 1 for the format), which are publicly available in Dutch via a webpage ([21](#)).
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46 126 ***Ethical approval***

47
48 127 Ethical approval was provided by the Dutch Association for Medical Education (NVMO) on June 19,
49
50 128 2017 (ID number 915).
51
52

53 129 54 130 ***Setting***

55
56
57 131 This study focused on the postgraduate training setting (residency training) in the southeast region of
58
59 132 the Netherlands. Table 1 presents a general overview of the Dutch medical undergraduate and
60

133 postgraduate training programmes. The region of study has chosen to apply a multifaceted approach
 134 of incorporating VBHC in residency training by having residents conduct small, pragmatic initiatives
 135 called “VBHC projects”. At the time of the study, VBHC training and projects were not mandatory,
 136 though greatly encouraged as a method for residents to learn about VBHC in different ways.

137

138 **Table 1. Overview of general characteristics of the Dutch undergraduate and postgraduate training**
 139 **programmes**

Name and structure	Duration	Qualification after graduation
Preclinical training (bachelor)	3 years	Bachelor of medicine
Clinical training (master)	3 years	Physician, M.D.
Resident not in training	Optional	-
Residency training or training for general practitioner	3 to 6 years	Medical specialist, general practitioner

140

141 ***The VBHC projects***

142 Residents were stimulated to critically assess daily healthcare and recognise potential VBHC dilemmas
 143 in practice. These dilemmas entail a wide range of problems or possibilities for improvement that
 144 residents would come across; for example, inefficiency in logistics, unnecessary costs spent on
 145 diagnostics, or a new treatment with fewer complications. Residents were then guided step-by-step.
 146 Firstly, they were offered the knowledge and skills to identify, measure and evaluate both costs and
 147 outcome. Secondly, they were encouraged to discuss VBHC dilemmas with the relevant stakeholders,
 148 consequently assessing the dilemma from multiple perspectives. These perspectives could be the
 149 patient’s, the doctor’s, other health care professionals’ and/or that from the health care organisation
 150 as a whole. Thirdly, residents had to determine goals for improvement or search for an effective
 151 alternative for current clinical practice. Finally, they reported to each other how they implemented
 152 their change or planned to implement their change, what facilitators and barriers they foresaw or
 153 encountered (potential or actual), and what they learned during the process. Altogether, this resulted
 154 in a VBHC project. In order to enhance the chance of successfully conducting such a project, the

1
2
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4 155 residents were encouraged to keep the projects relatively small-scale, i.e. with the goal to finish it
5
6 156 within 3 to 6 months.
7
8 157

9
10 158 ***Data collection and analyses***

11
12 159 *Data collection and analyses of text-based summaries*

13
14 160 VBHC projects were included in this study when a standard format was completed and published online
15
16 161 on the publicly available webpage (21), with a clear problem statement and potential costs and effects
17
18 162 identified as measured and valued from multiple perspectives (at least 2). If the data were incomplete,
19
20 163 an email and one reminder email were sent to request the missing information. If the data remained
21
22 164 incomplete, the VBHC project was excluded.
23
24

25
26 165 The final set of included VBHC projects was assessed by two independent researchers (CN, SV).
27
28 166 Data extraction of these projects involved a summary of the setting, medical specialty, focus of the
29
30 167 project, anticipated and achieved results, and learning effects in terms of the residents' self-perceived
31
32 168 CanMEDS competency development. Data extraction yielded a score for the learning effects and were
33
34 169 compared with data from the semi-structured interviews. Any disagreements were resolved through
35
36 170 discussion. The focus of the projects was categorised after an inductive process as medical education,
37
38 171 medical care and/or organisational efficiency. The medical education category included projects that
39
40 172 aimed to improve education for residents, either in terms of practical skills or theoretical knowledge.
41
42 173 The medical care category included projects that focused on improvement in the current quality of
43
44 174 care and/or direct reduction of healthcare costs. The organisational efficiency category included
45
46 175 projects that aimed to optimise processes in healthcare.
47
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49

50 176 *Data collection and analyses of semi-structured interviews*

51
52 177 Semi-structured interviews were held with residents who conducted a VBHC project and published it
53
54 178 in the publicly available online database (21). After the initial contact with a resident, a reminder
55
56 179 request was sent if there was no response. All interviews were performed by telephone or face-to-face
57
58
59 180 by one investigator (MK) under the supervision of a trained interviewer (CN). There was no prior
60

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2
3
4 181 relationship between the interviewer and the interviewees before the start of the study. Prior to
5
6 182 performing the interviews, a series of pilot interviews was held to train the interviewer and assess the
7
8 183 quality and feasibility of the topic list. The final topic list for the semi-structured interviews can be
9
10 184 found in appendix 2. The residents were asked to provide a general reflection of the process, and to
11
12 185 reflect on both successful and unsuccessful processes of implementation. If it appeared that no
13
14 186 implementation attempt was made, based on the interview data, the interview data was not included
15
16
17 187 in the analyses. Individual interview data were recorded and transcribed verbatim (MK).

18
19 188 The data were analysed by summarising information on the residents' self-perceived learning
20
21 189 of CanMEDS competencies and compared with data from the text-based summaries. Furthermore data
22
23 190 were analysed assessing the learning effects of VBHC, and gathering detailed information on
24
25 191 implementation facilitators and barriers. Data was clustered by two independent researchers (CN, SV)
26
27 192 applying the generally accepted principles of primary, secondary, and tertiary coding, in a constant
28
29 193 comparison (22), iterative approach. Regarding potential facilitators for and barriers to
30
31 194 implementation, this means reading through the transcripts inductively to find patterns (23, 24).
32
33 195 Finally, all interview data were searched for these patterns. These steps were executed by two
34
35 196 researchers (SV, CN), and in case of disagreement, dialogue followed until consensus was reached.
36
37
38

39 197

40 41 198 *Patient and public involvement*

42
43
44 199 None.
45

46 200

47 48 201 **Results**

49 50 202 *Text-based summaries*

51
52 203 From the 63 VBHC projects identified in the publicly available online database (21), 56 VBHC projects
53
54 204 were included and analysed (see figure 1). Fifty VBHC projects (89%) included in this study were
55
56 205 implemented in practice.
57
58
59
60

206 In Table 2, a general description of the 56 included VBHC projects is presented. For 14
 207 residents, the focus of their VBHC project was on more than one goal (e.g. medical education and
 208 medical care, or organisational efficiency and medical care).

209

210 **Individual semi-structured interviews**

211 Out of the 19 residents approached for the interview, 11 were included and analysed in this study (see
 212 figure 2). To some extent (n= 5), both the residents and their projects were included in the text-based
 213 summaries and the interviews.

214 Descriptive details of the VBHC projects conducted by the 11 residents interviewed are
 215 summarised in Table 2. More detailed information can be found in Appendix 3.

216

217 **Table 2. Specifics of the VBHC projects included**

Method		Text-based summaries	Interviews
Setting	University medical centre	38 (68%)	6 (55%)
	Non-academic	18 (32%)	5 (45%)
Medical specialty	Anaesthesiology	4 (7%)	2 (18%)
	Cardiology	1 (2%)	-
	Cardiothoracic surgery	2 (4%)	-
	Clinical pharmacology	3 (5%)	-
	Clinical genetics	3 (5%)	-
	Internal medicine	1 (2%)	-
	Neurology	1 (2%)	2 (18%)
	Neurosurgery	4 (7%)	1 (9%)
	Obstetrics and gynaecology	7 (13%)	1 (9%)
	Orthopaedics	6 (11%)	-
	Ophthalmology	2 (4%)	-
	Paediatrics	1 (2%)	2 (18%)
	Plastic surgery	1 (2%)	-
	Psychiatry	3 (5%)	1 (9%)
	Pulmonary medicine	3 (5%)	-
	Radiology	4 (7%)	-
	Rehabilitation medicine	1 (2%)	2 (18%)
	Surgery	7 (13%)	-
	Urology	1 (2%)	-
	Vascular medicine	1 (2%)	-
Focus of the projects	Organisational efficiency	14 (25%)	-
	Medical education	2 (4%)	1 (9%)
	Medical care	25 (45%)	1 (9%)

	More than one goal	14 (25%)	9 (82%)
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218

219 **CanMEDS competency development**

220 Data analysis of the text-based summaries and interviews revealed that self-perceived learning effects
 221 regarding CanMEDS roles were present for at least two competencies. See Table 3 and figure 3 for
 222 details, distribution and comparison.

223 Data from the text-based summaries showed that self-perceived learning effects regarding
 224 CanMEDS roles were evident in all respondents for at least two competencies. In addition, 93% of the
 225 residents trained three or more CanMEDS competencies when conducting a VBHC project. In order of
 226 frequency, the best trained competencies were 'leader' (n=50), 'communicator' (n=48) and
 227 'collaborator' (n=48).

228 The interview data showed a somewhat similar distribution of self-perceived learning regarding
 229 CanMEDS roles as the data from the text-based summaries (see table 3 and figure 3). In order of
 230 frequency, the best trained competencies found in the data from the interviews were 'collaborator'
 231 (n=11), 'leader' (n=10) and 'communicator' (n=9). A difference in the distribution of self-perceived
 232 learning was noted when comparing the data from the text-based summaries to the data from the
 233 interviews for the health advocate competency (n=11) and, to some extent, scholar (n=5), which
 234 were more often developed according to the interviewed residents. See text below for illustrative
 235 quotes on self-perceived learning regarding CanMEDS roles.

236

237 **Table 3. Self-perceived learning regarding the different CanMEDS competencies**

	<i>Medical expert</i>	<i>Scholar</i>	<i>Leader</i>	<i>Collaborator</i>	<i>Communicator</i>	<i>Professional</i>	<i>Health advocate</i>
<i>Text-based summaries</i>	18%	23%	89%	86%	86%	34%	43%
<i>Interviews</i>	9%	45%	91%	100%	82%	36%	100%

238

239

240 Supporting quotes were found for the most frequently trained competencies. R10 comment
241 on scholar: *"because I did a complete literature investigation to support the new protocol I*
242 *implemented."* R3 comment on leader: *"I learned a lot about the organisation of healthcare and how*
243 *many possibilities there still are for improvement."* R7 comment on collaborator: *"I learned that*
244 *supportive departments, for example the financial administration, are easily accessed, which gave me*
245 *great insight into the organisational structure, but also showed me that communication is sometimes*
246 *lacking."* R1 comment on communicator: *"[...] communication as well, by the high frequency of*
247 *presentations I had to do."* R1 comment on organisation: *"[...] because I gained great insight into the*
248 *structure of our organisation, financial background, who different stakeholders are, and how choices*
249 *are made."* R4 comment on health advocate: *"I learned about health advocacy because I tried to reduce*
250 *health care costs for the community without loss of quality of care."*

251

252 **Learning concepts of VBHC**

253 Concerning the concepts of VBHC, our data revealed a few important aspects of the residents' learning
254 process. Firstly, the resident needs to recognise the VBHC dilemma in clinical practice. Next, they need
255 to examine this dilemma from multiple perspectives. Finally, they need to balance costs versus
256 outcome regarding this dilemma from these multiple perspectives.

257

258 **Recognition of VBHC dilemmas in clinical practice**

259 Conducting VBHC projects included a step-by-step guidance and completion of the format. This
260 allowed the VBHC dilemma to be linked to clinical practice, facilitating the recognition of VBHC - or its
261 lack - in practice. All text-based summaries of VBHC projects included in this study (N=56) described
262 the VBHC dilemma by defining the costs and outcomes from multiple perspectives and the goal for
263 improvement or alternatives for practice (see appendix 1, items 2 and 3). The interviewed residents
264 (N=11) helped us to gain insight since they could explain how this format helped them to recognise the

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4 265 VBHC dilemma. R12: *"the format obliges you to walk through the process step by step. We often say*
5
6 266 *we do, but this helps us actually to do so, because you have an anchor."*

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10 268 *Learning multiple perspectives concerning VBHC*

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12 269 All interviewed residents (n=11) could explain the multiple perspectives they took into account when
13
14 270 analysing their VBHC problem. R5: *"I learned to reduce waste and made the process of patient letters*
15
16 271 *more efficient and improved the quality of care in the same process. So, patient, doctor and*
17
18 272 *organisation benefit."*

19
20
21 273

22
23 274 *Learning process of costs versus effects*

24
25 275 All interviewed residents (n=11) explained how they became more aware of the relationship between
26
27 276 both costs and effects (value) when conducting their VBHC project. For example, R8: *"we measured*
28
29 277 *the number of no-shows in the intervention group versus the group that received standard care, and*
30
31 278 *measured the revenues we missed out on because of the no-shows."* R7: *"I reduced costs without loss*
32
33 279 *of quality of care for the patient by reducing standardised laboratory tests upon admission."* A self-
34
35 280 perceived learning effect could also be described as an improvement in awareness and identification
36
37 281 of costs in a broader perspective. R4: *"We had a reduction in leading time for patient letters to the*
38
39 282 *general practitioner, from an average of a few weeks to at least 80% finished and sent within 5 days*
40
41 283 *after discharge. But the cost reduction and quality improvement I envisioned were not just the*
42
43 284 *reduction in leading time of the patient letter, but also in better care when the GP has adequate*
44
45 285 *information as soon as possible."* The interview data also revealed that the residents were able to
46
47 286 explain their learning regarding VBHC in clinical practice as well. R10: *"[...] every randomised controlled*
48
49 287 *trial we use or refer to in clinical practice that refers to cost in relation to quality reflects a moment*
50
51 288 *where we reflect on VBHC [...] we don't always recognise it, but it is the basis of VBHC."*

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59 290 ***Facilitators for implementation***

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3
4 291 Residents mentioned a number of facilitators for implementation, in part related to the step-by-step
5
6 292 process we use (see methods section for details). Firstly, a thorough problem analysis from multiple
7
8 293 perspectives is important. Secondly, the involvement of all important stakeholders seems essential.
9
10 294 Thirdly, an intrinsic motivation to resolve the problem at hand is a strong facilitator. Finally, support
11
12 295 from a supervisor or mentor seems important.
13
14
15 296

16 297 *Problem analysis*

17
18
19 298 Residents (n=6) stated that detecting and defining the problem is a very important facilitator and
20
21 299 relates to the first step in the process of conducting a VBHC project (see appendix 1, points 2, 3), in
22
23 300 which residents are stimulated to critically assess daily healthcare and recognise potential VBHC
24
25 301 dilemmas and assess all this from multiple perspectives. R4: *“A thorough investigation of the problem*
26
27 302 *and making sure we knew why and for whom the problem was relevant made implementation a lot*
28
29 303 *easier.”*
30
31
32 304

33 305 *Stakeholder involvement*

34
35 306 An important item to facilitate implementation (n=11) turned out to be the involvement and support
36
37 307 of all stakeholders as defined during the second step in the guidance by experts: stakeholder analyses.
38
39 308 R4: *“Involve all relevant stakeholders and create a sense of urgency and relevance”*. R2: *“Everybody*
40
41 309 *(doctors, nurses, secretarial staff) recognised the problem of a language barrier and wanted a change*
42
43 310 *to be able to take better care of patients who speak a different language [...].”*
44
45
46
47
48 311

49 312 *Intrinsic motivation*

50
51 313 Intrinsic motivation to solve the problem was a huge facilitator as well for many residents (n=5). R8:
52
53 314 *“[...] my interest and motivation turned a small project into a hospital-wide project.”*
54
55
56
57 315

58 316 *Support*

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4 317 A final facilitator many residents (n=7) mentioned was a mentor or supervisor who helped them with
5
6 318 potential barriers, and that they probably would not have been able to change anything without their
7
8 319 support. R6: *"The educational committee supported my project and supported the different residents*
9
10 320 *to investigate and implement possibilities. That was really helpful."*

321

322 **Barriers to implementation**

323 Self-perceived barriers were often the opposite of the facilitators related to the VBHC dilemma. For
324 example, there was no clear VBHC dilemma or no clear problem definition. A few distinct barriers were
325 mentioned, namely a lack of support, involvement of too many stakeholders, and problems with the
326 magnitude of the project.

327

328 *Support*

329 A major barrier for implementation was felt to involve the preconditions and technical aspects, for
330 instance, ICT or secretarial support to implement the VBHC project. R11: *"In the end, the ICT application*
331 *was not realised and therefore I could not implement my project."* Another barrier mentioned was the
332 lack of a supportive environment by a sufficient number of the stakeholders involved (n=6). Too few
333 could also be experienced as a barrier. R10: *"in the end I did not have enough support from the other*
334 *residents to implement my change although the educational committee was on board."*

335

336 *Stakeholders*

337 Involvement of too many stakeholders was described as a barrier. R11: *"I needed not only other*
338 *residents, but also different supervisors to be on-board with the plan, which I understood along the*
339 *way."*

340

341 *Magnitude*

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4 342 Finally, the extent of the project made it more difficult to implement, for instance when the whole
5
6 343 organisation was involved instead of just their own department (n=3). R11: *"because it became a*
7
8 344 *hospital-wide project, it is currently still not implemented."*
9

10 345

11 346 **Discussion**

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15 347 In this explorative mixed-methods study, different aspects of learning were identified from the
16
17 348 residents' perspective when conducting small, pragmatic VBHC projects. Firstly, conducting VBHC
18
19 349 projects was shown to contribute to developing different CanMEDS competencies, especially
20
21 350 communicator, collaborator, leader and health advocate. Secondly, residents learned to recognise
22
23 351 VBHC dilemmas in clinical practice. Finally, facilitators for and barriers to implementing VBHC
24
25
26 352 projects were explored. In the subsequent sections, these findings will be discussed more
27
28 353 extensively.

29
30 354 Our study has shown that by conducting VBHC projects, residents were provided with
31
32 355 opportunities to further develop at least two different CanMEDS competencies. Our data showed that
33
34 356 the 'leader', 'collaborator' and 'communicator' competencies were most often developed. These are
35
36 357 examples of the 'soft' competencies (25). Mastering these competencies is helpful when implementing
37
38 358 any change project, and this motivates residents to acquire them (26). In this study, the 'scholar' and
39
40 359 'health advocate' competencies were often mentioned, especially by the participants of the
41
42 360 interviews, more than in the text-based summaries. This was an unexpected and remarkable finding:
43
44 361 young medical specialists feel inadequately prepared for these specific competencies (4).

45
46
47
48 362 We showed that residents are facilitated to learn to recognise a VBHC dilemma in clinical
49
50 363 practice when conducting a VBHC project. Additionally, they perceived an improvement in awareness
51
52 364 regarding VBHC, which is an important step in teaching residents to deliver VBHC (27). Our data
53
54 365 supports that when residents conduct VBHC projects, recognition of VBHC dilemmas in medical
55
56 366 practice is facilitated if they: (i) perform a thorough investigation of the problem, (ii) explore potential
57
58 367 barriers and (iii) set up a viable project for implementation. The data might overestimate the learning
59
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4 368 effects because we only included those residents who believed their projects were viable for
5
6 369 implementation and those with the intrinsic motivation to make a change since participation in the
7
8 370 VBHC projects was voluntary. Intrinsic motivation has a known positive effect on change projects in
9
10 371 health care (28). For future research, it could be interesting to investigate if VBHC projects are fruitful
11
12 372 learning opportunities when mandatory in any postgraduate curriculum.

13
14 373 Finally, the self-perceived facilitators for and barriers to implementing a VBHC project during
15
16 374 residency training were extracted from the interviews. We believe them to be crucial for the successful
17
18 375 implementation of a VBHC project. The information revealed many similarities to the contemporary
19
20 376 literature on facilitators and barriers in change management (29-31). First, a thorough investigation of
21
22 377 the problem is crucial (31), specifically concerning the VBHC dilemma. This means investigating the
23
24 378 costs and outcomes from multiple perspectives (such as patient, organisation, doctor, nurses, and
25
26 379 supportive staff) and balancing these costs versus outcomes (32). This is crucial in our opinion to
27
28 380 establish a sense of urgency and/or relevance, which in turn is essential for a successful
29
30 381 implementation (33, 34). Next, it is important to identify stakeholders and get them involved (35, 36).
31
32 382 This is only possible via 'a clear VBHC dilemma', of relevance for those who are affected by it (34).
33
34 383 Subsequently, find a supervisor or mentor with enough influence to make the change happen and
35
36 384 someone who has control of resources; in a hospital, this could be several different people (29). Then
37
38 385 establish a plan of action, keep it small and simple, within your own scope of influence (37). Finally,
39
40 386 describe how the effects are going to be measured (i.e. in terms of costs and effects) and demonstrate
41
42 387 intermediate results (36). Ultimately, you need to consolidate and secure your new way of working
43
44 388 (29). Inspired by the work of other researchers in the field of change management (29-31), we
45
46 389 summarised the tips from this study in an overview checklist (see appendix 4). We hope to inspire and
47
48 390 guide residents who want to implement a VBHC project. We would advise any educator who is about
49
50 391 to support residents when implementing VBHC projects to use a similar format and combine structured
51
52 392 teaching with support by an expert in the field (19). This strategy adheres to the necessary
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393 requirements of knowledge, support, role models and reflection when it comes to teaching the
394 concepts of VBHC (19).

395

396 **Conclusion**

397 This study revealed the positive impact of incorporating VBHC projects within the residency training
398 programme. VBHC projects are resident-led and practice-based and proved to be an effective
399 educational method to learn and develop CanMEDS competencies and practise the concepts of VBHC
400 via learning-by-doing. Residents learn to recognise VBHC dilemmas, how to implement an effective
401 change and that they have the potential to influence medical care, medical education or efficiency in
402 health care. According to the residents, important facilitators for successfully implementing a change
403 are a thorough investigation of the VBHC dilemma combined with a thorough stakeholder analysis.
404 Practice points are presented in box 1.

405

Box 1: Practice points

- Introducing a societally relevant theme such as VBHC in residency training programmes is a promising strategy to enhance competency-based education.
- Residents develop different CanMEDS competencies when conducting a VBHC project, especially those of 'leader', 'communicator' and 'collaborator'.
- Residents learn to recognise VBHC dilemmas in practice when combining formal teaching with conducting VBHC projects.
- A thorough investigation of a VBHC dilemma combined with an in-depth stakeholder analysis are key to successfully implementing a VBHC project.

406

407 ***List of abbreviations***

408 CanMEDS Canadian Medical Education Directives for Specialists

1
2
3 409 VBHC Value-Based Healthcare

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6 410

7
8 411 **Contributors**

9
10 412 SV analysed and interpreted all data and was a major contributor in writing the manuscript. CN
11
12 413 analysed and interpreted data and was a major contributor in writing the manuscript. BE and SE were
13
14 414 involved in the design of the project. MK performed the interviews and analysed data. LS contributed
15
16 415 in the analysis and interpretation of data. IH, LPS, KW and WM contributed to writing the manuscript
17
18 416 and the revisions. All authors read and approved the design of the study and final manuscript.

19
20 417 **Competing interests**

21
22 418 The authors declare no competing interests.

23
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25
26 420 There was no funding for this research project.

27
28 421 **Data availability statement**

29
30 422 Project information is available via <https://www.oorzon.nl/doelmatigheidsinitiatieven-oor-zon>.

31
32 423 Interview data are available upon reasonable request.

33
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35
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37
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41
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32 514 **Figure titles**

33 515 **Figure 1. Flowchart on selection and exclusion of text-based summaries**

34 516 **Figure 2. Flowchart on selection and exclusion of individual semi-structured interviews**

35 517 **Figure 3. Self-perceived learning regarding the different CanMEDS competencies**

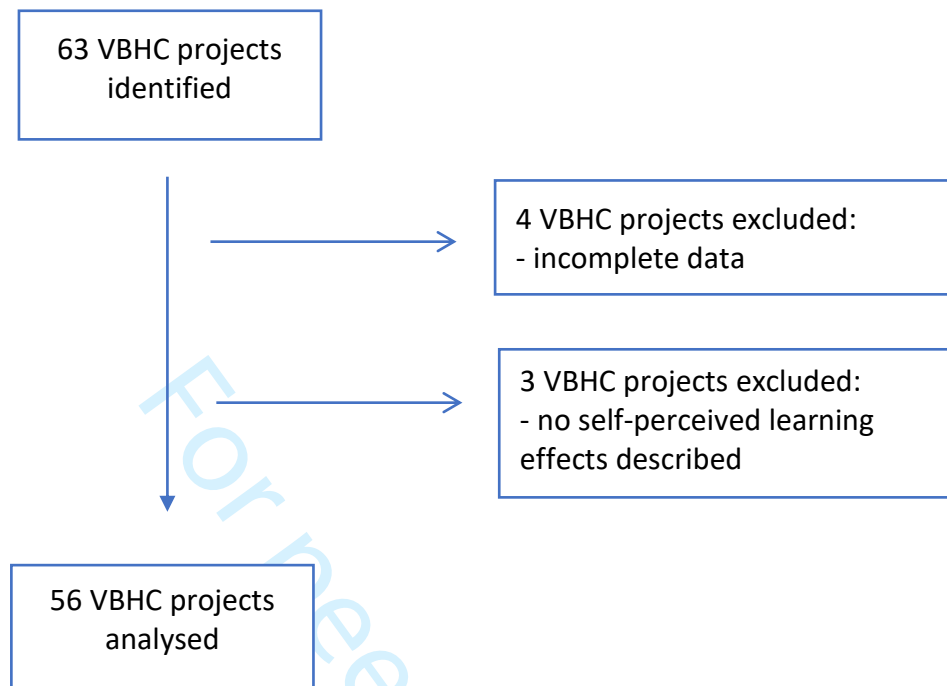
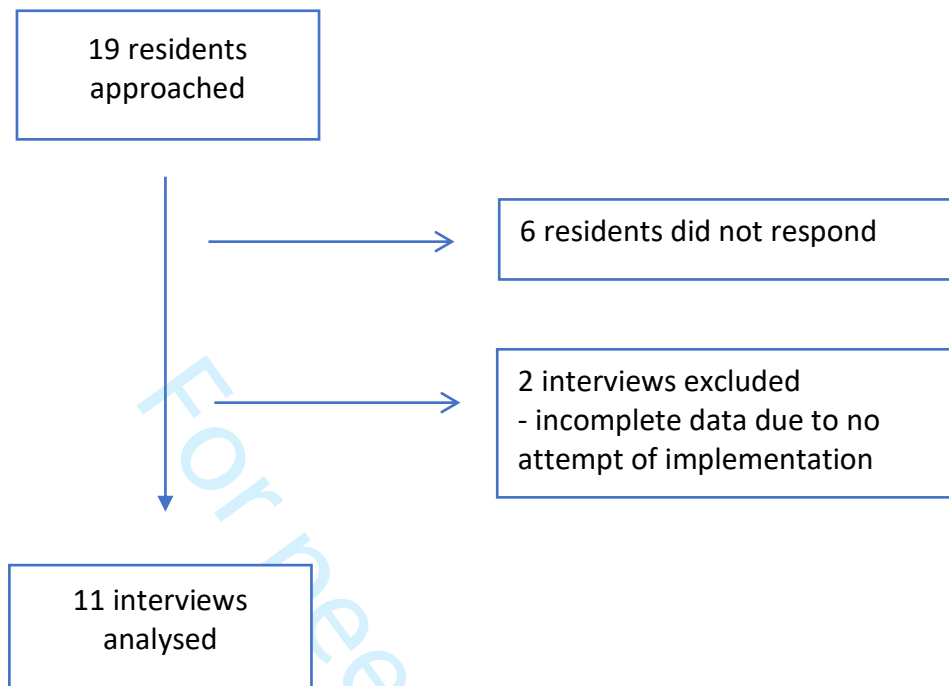
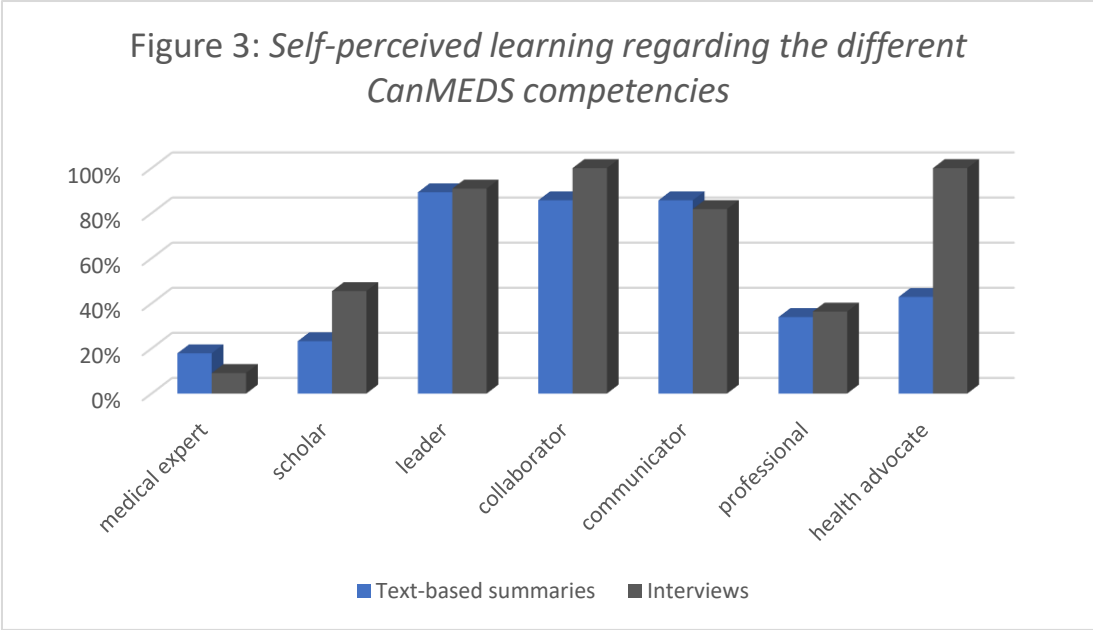
Figure 1: *Flowchart on selection and exclusion of text-based summaries*

Figure 2. Flowchart on selection and exclusion of individual semi-structured interviews



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peer review only

Appendix 1: Format VBHC projects (multiple 2019)

Format VBHC project <i>[title of project]</i>	
ABSTRACT (Max. 150 words)	
A) What does this project contribute to the improvement of the quality of care at your department or organisation?	
B) How are the general competencies (for example communicator, collaborator, leader, health advocate and professional) trained and evaluated by conducting and implementing this VBHC project?	
C) How will you secure this VBHC project within your organisation or at your department?	
1) Medical specialty:	
2) Issue:	<i>[describe with a max. of 150 words what the problem or issue is you would like to change with this project]</i>
3) Goal of the project:	<i>[describe what your main goal is]</i>
4) Plan of action:	<i>[describe your plan of action stepwise, max. 200 words. Describe the procedure and your plan of implementation. Explain both analysis and plan of action]</i>
5) Aimed results:	<i>[describe, max. 150 words, your aimed results of this VBHC project, in terms of costs and effects]</i>
6) Achieved results:	<i>[describe, max. 150 words, your results so far, in terms of costs and effects]</i>
7) Evaluation:	<i>[describe, max. 150 words, how you will evaluate the costs and effects of your VBHC project, in the long-term]</i>
8) Consolidate:	<i>[describe, max. 150 words, how you will institutionalize this project within the current structure of the organisation or department]</i>
9) Generalizability:	<i>[describe if your results might be applicable at other departments, organisations or regions]</i>
10) Role resident:	<i>[describe your role in this VBHC project]</i>
11) Learning effects:	<i>[describe what you learned by executing this project, how you learned this and how evaluated what you have learned]</i>
12) Mentor:	<i>[describe the role of the mentor / supervisor regarding the execution of the VBHC project]</i>

I agree this information will be published at the OORZON (Southeast region of Netherlands) website.

Appendix 2: Topic list for semi-structured interview

The topic list was constructed by two experienced researchers in this field, minor changes were made after a pilot interview.

VBHC- Projects	1) General information - Definition of VBHC & position in PGME - Goal of own VBHC project - Orientation (education, process, care delivery, ...)
	2) Implementation - Enhancing factors - Hindering factors
	3) Learning goals and learning curves - initial goal - achieved goal
	4) Self-perceived competency training - components trained & developed
	5) Self-perceived effect on influencing medical care - patient outcomes and experiences - costs (for example in monetary terms, efficiency, others)
	6) Embedding within organisation - reasons - enhancing or hindering factors

Appendix 3: Basic characteristics and focus of projects of the residents interviewed

	Specialty	Impl.*	Primary focus	Res.**	Explanation of exact focus
R1	Neurosurgery	Yes	Education	No	Development of a training session for other residents on registration and finances in their department
R2	Anesthesiology	Partly	Care and efficiency	No	ICT application to register any language barriers and provide helpful tools to overcome this language barrier
R3	Anesthesiology	Partly	Care and efficiency	No	ICT application to register any language barriers and provide helpful tools to overcome this language barrier
R4	Rehabilitation	Yes	Care and efficiency	No	Improving the leading time of patient letters
R5	Neurology	Yes	Care and efficiency	No	Implementation of digital patient letters to improve lead time
R6	Pediatrics	Yes	Care and efficiency	No	Give residents a day at another speciality to learn from each other and see possibilities to make work more efficient
R7	Rehabilitation	Yes	Care	Yes	Stop standard laboratory testing on admittance, only perform test when necessary
R8	Psychiatry	Yes	Care and efficiency	Yes	Send a standard SMS reminder before outpatient consults to reduce the number of no-shows
R9	Gynaecology	Yes	Care and efficiency	Yes	Direct removal of a catheter after a laparoscopic hysterectomy
R10	Pediatrics	No	Care and efficiency	No	Implementing a new structure for duty schedules to bring more continuity on the ward
R11	Neurology	No	Care and efficiency	No	ICT application to show when a patient had completed in hospital treatment and is waiting for a bed elsewhere

* Implemented at time of the interview.

** VBHC project was part of a research project or PhD trajectory

Appendix 4: Tips for residents' performing a VBHC project within a modified model of change

Examine the VBHC problem thoroughly

- *Complete assessment of the current situation from multiple perspectives (patient, doctor, organisation, etc)*
- *Take the culture of the organisation into account*

Establish a sense of urgency and/or relevance

Identify potential problems that could stand in the way of your change

- *Identify and involve all stakeholders*

Form a powerful coalition with enough power to lead the change

Different key roles:

- *Sponsor and/or advocate (can be a supervisor or mentor for instance)*
- *Implementer (often resident)*
- *Change agent (often resident)*

Create a vision and develop strategies for achieving that vision

- *keep it small and keep it simple, within your scope of power*

Communicate your vision

Plan for short-term wins

- *make sure you can show what is improved*

Consolidating improvement and still produces more change

- *implementation is more than changing a protocol. All employees involved need to work in the new way.*

Institutionalizing your change so it is incorporated in the new culture

- *make sure you can show what is improved to support the sense of urgency to stick to the new way of working*
 - *secure the new way of working in ways that are not solely depending on your presence*
-

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study's design with a commonly used term in the title or the abstract	2
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	3-5
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(a) <i>Cohort study</i> —Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up <i>Case-control study</i> —Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls <i>Cross-sectional study</i> —Give the eligibility criteria, and the sources and methods of selection of participants	6-8
		(b) <i>Cohort study</i> —For matched studies, give matching criteria and number of exposed and unexposed <i>Case-control study</i> —For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6-8
Bias	9	Describe any efforts to address potential sources of bias	n.a.
Study size	10	Explain how the study size was arrived at	8,9
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	10
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	n.a.
		(b) Describe any methods used to examine subgroups and interactions	n.a.
		(c) Explain how missing data were addressed	n.a.
		(d) <i>Cohort study</i> —If applicable, explain how loss to follow-up was addressed <i>Case-control study</i> —If applicable, explain how matching of cases and controls was addressed <i>Cross-sectional study</i> —If applicable, describe analytical methods taking account of sampling strategy	-
		(e) Describe any sensitivity analyses	

Continued on next page

Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8,9
		(b) Give reasons for non-participation at each stage	8,9
		(c) Consider use of a flow diagram	8,9
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	n.a.
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	n.a.
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time	n.a.
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure	-
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	-
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	-
		(b) Report category boundaries when continuous variables were categorized	-
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	-
Discussion			
Key results	18	Summarise key results with reference to study objectives	15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	15, 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	15, 16
Generalisability	21	Discuss the generalisability (external validity) of the study results	15- 17
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	n.a.

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at www.strobe-statement.org.