

Article

Building bridges: engaging medical residents in quality improvement and medical leadership

JUDITH J. VOOGT^{1,2}, ELIZABETH L.J. VAN RENSEN³,
MARIEKE F. VAN DER SCHAAF⁴, MIRKO NOORDEGRAAF²,
and MARGRIET ME SCHNEIDER⁵

¹Staff Department Executive Board, University Medical Center Utrecht, Utrecht, the Netherlands, ²Public Management, Utrecht School of Governance, Utrecht University, Utrecht, the Netherlands, ³Quality & Patient Safety Department, University Medical Center Utrecht, Utrecht, the Netherlands, ⁴Educational Sciences, Utrecht University, Utrecht, the Netherlands, and ⁵President of the Executive Board, University Medical Center Utrecht, Utrecht, the Netherlands

Address reprint requests to: Judith J. Voogt, Staff Department Executive Board, University Medical Center Utrecht, P.O. Box D01.343, Heidelberglaan 100, 3508 GA Utrecht, the Netherlands. Fax: +31302505400;
E-mail: j.j.voogt@umcutrecht.nl

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Abstract

Objective: To develop an educational intervention that targets residents' beliefs and attitudes to quality improvement (QI) and leadership in order to demonstrate proactive behaviour.

Design: Theory-driven, mixed methods study including document analysis, interviews, observations and open-ended questionnaires.

Setting: Six Dutch teaching hospitals.

Intervention: Using expertise from medicine, psychology, organizational and educational sciences we developed a situated learning programme named Ponder and IMProve (PIMP). The acronym PIMP reflects the original upbeat name in Dutch, Verwonder & Verbeter. It has a modern, positive meaning that relates to improving your current circumstances. In quarterly 1-h sessions residents are challenged to identify daily workplace frustrations and translate them into small-scale QI activities.

Main outcome measures: Organizational awareness, beliefs and attitudes to QI and organizational responsibilities, resident behaviour, barriers and facilitators to successful learning and the programme's potential impact on the organization.

Results: Overall, 19 PIMP meetings were held over a period of 3 years. Residents defined 119 PIMP goals, resolved 37 projects and are currently working on another 39 projects. Interviews show that PIMP sessions make residents more aware of the organizational aspects of their daily work. Moreover, residents feel empowered to take up the role of change agent. Facilitators for success include a positive cost-benefit trade-off, a valuable group process and a safe learning environment.

Conclusion: This article demonstrates the added value of multidisciplinary theory-driven research for the design, development and evaluation of educational programmes. Residents can be encouraged to develop organizational awareness and reshape their daily frustrations in QI work.

Key words: quality improvement, leadership, postgraduate education

Introduction

The medical profession is facing major change as diseases, diagnostic instruments and treatments continuously increase in complexity. There is a growing societal demand for accountability, transparency, cost-efficiency and quality of care [1, 2]. These changes bring about new responsibilities for physicians, responsibilities that focus on the organizational rather than medical side of health care provision [3, 4]. To prepare physicians for this changing context, medical education should incorporate the organizational aspects of medical work, such as quality improvement (QI) and leadership, in postgraduate training [5, 6]. Multiple studies highlight that residents are not fully prepared for their organizational responsibilities and medical educators are struggling to find suitable solutions to this problem [7–13].

The literature on the sociology of professions offers an explanation for this struggle—professionals traditionally hold a negative attitude toward managerial practices. This is especially true for classic professionals, such as medical doctors [1, 14, 15]. Doctors are trained within a ‘professional logic’ that embodies values such as time, quality, learning and patient-centredness. As healthcare becomes more complex, values from the organizational logic, such as control, risks, efficiency, costs and accountability, become more prominent and cause physicians to feeling disengaged. This sentiment causes friction when attempts are made to involve junior doctors in QI and leadership roles, which are both nested in the language and symbols of the organizational logic. This is a problem because organizational roles are actually very close to the core value of the profession, improving the quality of care for patients. This study aims to turn this disconnection around by reframing the organizational roles to the professional values and thereby connecting the professional and organizational worlds.

Medical scholars are used to evaluating the effectiveness of new methods but are generally not interested in consulting grand or middle-range theories to understand the mechanisms that explain ‘how’ and ‘why’ a method works [16]. A recent publication on QI work emphasized the value of a theory-driven approach for strengthening programmes and evaluating their effectiveness [17]. Our study uses knowledge from medicine, psychology, public management and educational sciences as sources for in-depth knowledge on professional learning.

The aims of this article are 3-fold: (i) to demonstrate how organizational postgraduate education can be grounded in theory by deliberately using theory in the design, development and evaluation of educational programmes; (ii) to describe the development, implementation and evaluation of the Ponder and IMProve (PIMP) programme, a newly developed method for engaging residents in their organizational responsibilities; and (iii) to present the results of a Dutch mixed methods study of the PIMP programme.

Developing the PIMP programme

The PIMP programme originated at the University Medical Center Utrecht in the Department of Internal Medicine. The creators of the programme had observed residents encountering many obstacles to providing good care, calling for improvements but not knowing how to address the problems themselves. Several studies confirmed this observation and showed the residents’ need for additional knowledge, skills and authority to bring about change [9, 11]. This provided the starting point for translating QI and leadership to the professional world of junior doctors. Using their day-to-day experiences and frustrations as the starting point for training opportunities, the PIMP programme stays close to the residents’ professional

context. The acronym PIMP has a modern meaning that relates to improving your current circumstances (e.g. ‘pimp my ride’) and has the same positive, upbeat sense as the original name in Dutch, *Verwonder & Verbeter*.

Proactive behaviour is an essential component for both QI and leadership. Behavioural psychology research demonstrates that for any behaviour to take place, the combination of underlying beliefs (e.g. self-efficacy beliefs, outcome beliefs and control beliefs), facilitators (e.g. training, knowledge and skills) and external barriers (e.g. lack of organizational opportunities) should benefit the intended behaviour [18]. Most components of Quality and Safety curriculums focus on either facilitators (training) or external barriers, but do not target the underlying attitudes and beliefs of residents [19]. An important requisite for proactive behaviour is the resident’s perceived level of control, the belief that one has the ability to influence the environment [20, 21]. The PIMP programme was developed to enhance both control beliefs and proactive behaviour in a protected setting that also carefully considers the interests of other healthcare workers and patients. PIMP is designed to complement existing Quality and Safety curriculums. The literature on training residents in QI has shown the benefit of taking an experiential approach [16, 22].

For the final design of the PIMP programme, the authors combined their own teaching experience with knowledge gained from experiential learning, the integrated model of behaviour prediction, self-determination theory and professionalism literature (Table 1).

Final design PIMP programme

The formal part of the PIMP programme asks for a relatively small time investment (four 1-h meetings a year) and should be considered a part of a larger QI curriculum. During PIMP meetings, residents are challenged to identify opportunities for improvement in their departments, called ‘PIMP goals’ (Table 2). First, all participating residents are divided into groups of three to four to brainstorm on their PIMP goals. During this part of the session, participants focus on sharing their experiences. The facilitator of the meeting should be careful that the brainstorming does not evolve into premature problem-solving and that the residents start discussing a multiplicity of issues and ideas. Second, the groups of residents taking part in the meeting exchange lists. Each group then selects their top three PIMP goals from the new list. Third, during the plenary inventory, the groups share their top three goals and give additional information on why these PIMP goals interfere with their daily work and stop them from providing high quality patient care. Fourth, the residents collectively decide which PIMP goals should form the starting point for PIMP projects, by individually allocating points to the goals that are considered both urgent and beneficial for patient care. This can be done with a tally of votes on a whiteboard.

The facilitator’s role is to assess whether or not a goal is feasible, within the resident’s sphere of influence (e.g. redesigning the whole Emergency Room is not), and beneficial to the quality of care for patients. At the end of the PIMP meeting, residents sign up voluntarily to participate in a project group. These project groups consist of two to four residents responsible for the project, who formulate the first steps for taking action on how to solve the problem. In the course of the project, the team members can ask for help from colleagues (also from other disciplines) and senior staff. In the months following the PIMP meeting, residents formulate and implement a plan for change with their group. Because the programme tries to reflect the daily work of residents as much as possible, the residents are not given additional time to work on their QI activities.

Table 1 Course design considerations based on self-determination theory, experiential learning, professionalism and behavioural psychology literature [1, 14, 16, 20, 22–28]

Design considerations		PIMP course elements
Self-determination theory [26, 27]	Autonomy	<ul style="list-style-type: none"> • Non-compulsory sessions • Bottom-up contribution by residents • Residents choose which PIMP goals they want to improve. The session facilitator does not cherry-pick topics or allocate PIMP goals to residents
	Relatedness	<ul style="list-style-type: none"> • Residents formulate and carry out the improvement plans themselves • Non-hierarchical: all residents (junior and senior) are invited to pitch their ideas • All residents get the opportunity to speak their mind; their ideas are appreciated • Focus on QI as a group effort
Integrated model of behaviour prediction [18]	Control beliefs	<ul style="list-style-type: none"> • Small, feasible QI activities within the resident's sphere of influence
	Self-efficacy beliefs	<ul style="list-style-type: none"> • Verbal encouragement of residents in PIMP meetings • Vicarious experience shared in listening to the stories of others
	Outcome beliefs	<ul style="list-style-type: none"> • Programme mentality: the residents' contributions matter, not the outcome • Input is valued; medical educator creates leverage among peers and supervisors
Experiential learning [23]	Informal (workplace) learning	<ul style="list-style-type: none"> • PIMP goals are based on real workplace situations • QI work is carried out in the workplace • To reflect the residents' usual workload, no time off from clinical duties to work on their PIMP goals is provided regularly • Focus on collaboration with peers

Table 2 Examples of PIMP goals and improvement activities

Examples of PIMP goals	Improvement activities
Why do nurses frequently come to me for non-urgent questions about patients, after the clinical rounds? These interruptions make me lose focus on my own tasks.	The resident arranged a meeting with the nursing manager and clinical supervisor. Evidently these questions are important for the nurses to make progress. Together they agreed to introduce a regular moment for nurses to come forward with (non-urgent) questions. Junior nurses will first ask their supervisor for help before asking the doctors' advice.
Why is there no record or overview of the number of days an IV line is <i>in situ</i> ? This can cause line infections.	Residents met up with IT personnel and nurses to discuss adding a new measurement box in the digital patient record to give a quick overview of how long the line is <i>in situ</i> and the current indication for the IV line. This way residents need to ask themselves regularly whether the IV line should be changed or removed.
Why is the attending physician not always at handovers?	Three residents and a department manager formed a project group to revise the agreement on handovers. They consulted peers and supervisors and used a National Society for Internal Medicine guideline to develop a comprehensive and efficient handover. The new handover guideline states that all attending physicians should be present at handovers. The project group routinely uses questionnaires to evaluate whether the handover meets expectations.

Consequently, QI gets incorporated in the daily working routines of physicians instead of being perceived as an extra-curricular activity. However, if residents make a plan for change and ask their supervisor for free time, the supervisor could consider this question like any other request.

In the initial format, the facilitator of the meetings did not receive any personal training. Before the first meeting, the session facilitators received a manual that outlined the format of the PIMP session and included tips that resemble those shown in Table 1. It is recommended to involve an additional employee such as a department secretary, policy adviser or the department's Quality and Safety expert to provide support for the PIMP programme. This employee could invest one or two hours a week to help the residents to move forward whenever they get stuck with their change plan and could send them occasional e-mail reminders, requesting updates on the PIMP projects. In the following PIMP meetings, residents briefly report back on their progress along with their improvement activities and receive feedback if necessary.

Evaluating the PIMP programme

Methods

The PIMP programme was implemented in six residency programmes across the Netherlands to evaluate its effect on resident learning, analyse underlying mechanisms for learning and identify barriers and facilitators for successful implementation. The Kirkpatrick model for training evaluation was used to assess the impact of the intervention on resident learning (Table 3) [29, 30]. Because the PIMP programme's main target is the attitudes and beliefs of residents, the impact of the PIMP goals on the organization as a whole was only measured by proxy variables (Table 3). Participating departments enrolled voluntarily after becoming acquainted with the teaching method at a workshop or conference. Appendix 1 describes the characteristics of the participating departments.

The mixed methods research design of the study included interviews, observations of PIMP meetings, document analysis of the

Table 3 Impact of the PIMP programme on resident learning

Kirkpatrick level as interpreted by Yardley and Dornan [30]	Method of evaluation	PIMP programme effect on resident learning
2a: Attitudes	Interviews with participants and programme directors Open-ended questionnaires	Awareness of the organizational part of the hospital. Awareness of own position and responsibilities. Improvement to underlying beliefs (control, self-efficacy, outcome)
2b: Knowledge and/or skills	Evaluation of QI work and improvement plan Interviews with participants and programme directors	Identify organizational thresholds, identify and assemble stakeholders for a meeting; make plans for improvements
3: Behaviour	Analysis of documentation on PIMP meetings Evaluation of QI activities Interviews with participants and programme directors	Voluntary participation in PIMP meetings. Input during PIMP meetings. Take on PIMP projects voluntarily, come up with and carry out improvement plans
4a: Organizational practice	QI Results from documentation and interviews	Resolve a PIMP goal by changing daily routines

PIMP goals raised and analysis of the communication concerning the PIMP programme. An observation list for interpreting PIMP meetings (Appendix 2) was created, based on the theoretical considerations, (Table 1). Topic guides were developed to direct the structure of the interviews, based on the information obtained in the first stage of the research programme (Appendices 3 and 4). Residents received an open-ended evaluation sheet after the PIMP meeting (Appendix 5). The first author conducted all interviews and observations. The research team maintained reflexivity by discussing and challenging established assumptions.

Participants

All residents of the participating departments were invited to the PIMP meetings by their programme director or by the resident who initiated the PIMP programme in their department. The average number of participants at sessions ranged from 5 to 16, depending on the size of the residency group and whether or not attendance was compulsory. The level of experience also varied among residents. Selected on the basis of purposeful sampling, residents, programme directors and support staff were invited to 30–45 min interviews. This resulted in 24 interviews. Appendix 6 describes the respondent demographics. An open-ended evaluation sheet was distributed among participants ($n = 20$) at three of the six locations. The response rate was 80%.

Ethical approval

This study falls outside the scope of the Dutch Law on Medical Research (WMO). All professionals were given the opportunity to refuse to participate and gave their verbal consent for voluntary participation. All professionals were informed that they were being observed and audiotaped for research purposes and gave verbal consent. All study material was anonymized and saved by just one researcher.

Data collection

Demographic data were collected during the interviews with respondents and information on the hospitals was obtained from their latest annual report. Interviews were recorded, anonymized, transcribed and supported by field notes. Interviews were conducted between October 2013 and December 2014. Information on the PIMP goals that arose at PIMP meetings was retrieved from the

researcher's observational notes and from the session facilitator's reports of the meetings.

Data analysis

One researcher (J.V.) coded the transcripts using qualitative data analysis software (NVivo). Ambiguous statements were discussed by two researchers (J.V. and E.v.R.). A process involving open coding, analysis and interpretation identified the relevant themes. To assess the nature of the PIMP goals, all goals were classified using the medical version of the Eindhoven Classification Model (Appendix 7). This method is generally used to classify root causes of medical errors and was now used as a guide for categorizing PIMP goals [31]. To assess the effect of the improvement activities on the quality of care, the PIMP goals were classified into one of six domains of healthcare quality as introduced by the Committee of Quality of Health Care in America (Appendix 8) [32]. This study added a seventh category that applied to the job satisfaction of residents. All PIMP goals were independently classified by two researchers (J.V. and E.v.R.), who discussed the differences in outcome and any disagreements until consensus was achieved.

Results

During the total course of the PIMP programme, the residents raised 119 PIMP goals. By the end of data collection, 37 PIMP projects were resolved successfully, 39 PIMP projects were ongoing and 43 PIMP goals did not result in any improvement activities. Most PIMP goals were based on organizational problems (64%) or technical problems (28%). Of the 119 goals, 45 topics were on improving the efficiency of healthcare; 44 PIMP goals pointed out safety concerns and 12 topics were classified as focusing on patient-centredness. Six PIMP goals focused on making healthcare more timely and two addressed the effectiveness of healthcare. None of the PIMP goals focused on equitable care while ten items focused on increasing the job satisfaction of the residents.

Impact of PIMP on resident learning

During interviews, residents stressed that PIMP meetings made them more aware of organizational aspects of healthcare delivery. According to the residents, they achieved this by listening to updates on QI work undertaken by other residents and by taking on QI

work themselves. Residents who took on a PIMP goal felt able to identify relevant stakeholders, barriers and facilitators to achieve successful implementation.

‘They learn that there is more to the hospital than their consulting room. For example, one resident visited the Occupational Health Department during her improvement activities. She told me she had never realized that 30 people work in that department as well...’—Support staff member

An important theme that arose from the interviews was that the PIMP programme made residents feel heard and that their superiors were taking them seriously. This made them feel empowered to take on change, regardless of their level of experience.

‘The simple fact that people higher up in the organization pay attention to my problems gives me the courage to keep fighting to make changes...’—Resident

Residents became aware of their own position in the hospital and its corresponding responsibilities: they felt that they should stop pointing fingers and start taking ownership of their problems. Some residents did not feel that the PIMP programme contributed to their education. Some residents missed robust tools for planning and evaluating their QI work. Table 3 summarizes the impact of the PIMP programme on resident learning.

Barriers and facilitators for successful implementation of the PIMP programme

All respondents were questioned about contextual factors that, in their opinion, would either contribute to or hinder successful implementation of the PIMP programme. Three main lines of argument emerged from the data.

Cost-benefit trade-off

To make participation in PIMP meetings worthwhile, residents felt that there should be a proper cost-benefit trade-off in terms of input of their time versus utility of the programme for their working routines. Residents wanted the session to be a useful tool to solve issues they encounter (patient-centredness, etc.) and make their work more efficient. Nearly all respondents mentioned that they would like to measure the impact of the work done on the quality of care.

Interviewer: In your opinion, when would the PIMP programme be successful?

Programme Director: When there is a clear improvement in outcome measures.’

One key factor for success appeared to be the residents’ affinity for the subject. Although supervisors were instructed not to interfere by appointing PIMP goals, peer pressure sometimes caused a PIMP goal to be linked to a resident who initially did not want to take on this particular task. It threatened their autonomy and therefore their intrinsic motivation [26]. Residents especially felt as if they could not refuse an offer when their programme director led the PIMP meeting.

Valuable group process

Respondents viewed PIMP sessions as easy, accessible meetings that were useful for every resident. They emphasized the importance of an enthusiastic group process. PIMP meetings were a platform for

residents to talk with colleagues about everyday problems. They enjoyed sharing experiences and helping their colleagues.

‘I would go to a session just to help my colleagues and see what kind of PIMP goals they had come across in the day. We probably experience the same problems, but if you never discussed these topics you might think it could only happen to you...’—Resident

Safe learning environment

According to the residents, a safe learning environment was a crucial success factor for implementing the PIMP programme. The ability to speak up and be appreciated rather than criticized was an important incentive for residents to come forward with their PIMP goals.

In contrast, letting the programme director lead the session could be a barrier if their presence was not perceived as safe. In this event, the residents felt they could not address the ‘real’ issues that were bothering them. When the rest of the ward perceived the PIMP goals and QI work as ‘telling tales’ rather than constructive criticism, the residents did not feel empowered to engage in their QI activities.

Discussion

The results of this mixed methods study show that residents became aware of their organizational responsibilities through discussing, formulating, prioritizing and executing small practice-based improvement activities in the PIMP programme. Insight into organizational processes was created through plenary discussion of (ongoing) improvement projects. In addition, the residents gained an awareness of their own influence and responsibilities in organizing their daily practices, even when they did not adopt an improvement project of their own. This is line with the literature on behaviour prediction, which shows that vicarious experience and control beliefs are important for (proactive) behaviour.

Moreover, this study showed that the residents wanted to learn more about practical QI tools at the PIMP meetings. This need could be explained by the diverse background of the residents. Up until a few years ago, not every Dutch curriculum included Quality and Safety education, which means that this generation’s residents were trained during a transition phase. Consequently, the level of QI expertise varied between learners. This could be a reason to introduce basic QI principles such as the Plan-Do-Study-Act cycle at PIMP meetings.

One of the limitations of this study is the open coding of the available material, which was conducted by only one researcher. To keep this constraint to a minimum, two researchers (J.V. and E.v.R.) held daily consults. Moreover, selection bias could have occurred in the interviews. Some residents were put forward by their supervisor because of their initial interest in leadership. An additional question was added to the interview guide to identify the degree of organizational experience that the residents had.

The informal, professional-focused approach of the PIMP programme could also have its disadvantages. The balance between the sometimes self-centred focus of residents and attention to healthcare processes that benefit the patient should be carefully weighed at PIMP meetings. Emphasizing the ultimate goal of the PIMP programme (improving the quality of care for patients) is a strategy used to try to prevent this doctor-focused mind set from taking place. Here lies an important role for the facilitator of the PIMP meeting. The facilitator plays an important part in aligning the

professional and organizational worlds and should thus pay close attention to the framing of the discussions at PIMP meetings. The link between PIMP goals and the six domains of quality in healthcare could be made more explicit at PIMP meetings. These domains have the potential to connect to residents, educators and managers and could thus contribute to creating a common language between these professional groups. To that end, involving a Quality and Safety expert in the PIMP meetings could be beneficial.

Finally, the ultimate goal of the PIMP programme is to broaden the scope of residents and empower them to become agents of change whose intrinsically motivated contributions benefit the quality of healthcare. Transforming residents into proactive QI advocates cannot be done by PIMP alone. The programme should be embedded in an educational culture that appreciates the residents' contributions and provides them with additional opportunities (e.g. time, knowledge and skills) to flourish.

Conclusion and implications

To conclude, this article met the three goals stated in the introduction. First, by demonstrating that it is possible to engage residents in their organizational roles and increase their sense of empowerment by formulating and executing small-scale QI activities based on workplace experiences. Emphasizing the organizational aspects of providing high quality healthcare could be an important first step in preparing residents for their new organizational responsibilities. The PIMP programme should be integrated in a curriculum that includes formal QI training. Second, this article shows the advantages of using existing theories to create meaningful learning opportunities that consider the medical professional culture. Third, the PIMP programme evaluation showed that training the facilitators of the PIMP meetings is important for the success of the programme. Our data suggest that stimulating residents' organizational awareness makes residents more keen to apply QI on the job. By simultaneously enhancing residents' self-efficacy in QI, this programme could positively influence the quality of healthcare for patients as well.

Abbreviations

PIMP = Ponder and IMProve; QI = quality improvement; SDT = self-determination theory.

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Appendix 1. Characteristics of departments participating in the evaluation of the PIMP programme

Specialty	Type of hospital	Approximate number of employees	Mean number of residents in residency group	Mean number of residents attending session	Stage of education	Compulsory	Facilitator
Internal medicine	University Hospital	11 000	>20	10	Advanced	No	Programme director
Surgery	University Hospital	11 000	10–20	No information available	Mixed	No	Programme director
Gastroenterology	University Hospital	10 000	<10	5	Advanced	No	Resident
Paediatrics	Affiliated general teaching hospital	2500	<10	6	Early	Yes, during educational meeting	Programme director
Neurology	University Hospital	12 000	10–20	16	Mixed	No	House consultant
Psychiatry	University Hospital	11 000	>20	14	Mixed	Yes, during educational meeting	Medical educator

Appendix 2. Observation sheet PIMP session

- Course of the session: structure, promptness, duration
- Facilitator: experience, guidance, enthusiasm, encouraging bottom-up participation of residents, interruptions
- Participation: number of residents, contribution of residents, enthusiasm, number PIMP aims
- Hierarchy: who is speaking up, culture (open/closed), interruptions, atmosphere, how does the group emphasize important topics, project assignment

Appendix 3. Topic guide interview resident

Introduction: research project and aim of the interview

1. Competency based education
 - Is your specialty training programme based on the CanMEDS roles?
 - How are they trained? Do you train them in specific situations?
 - Which CanMED role are you most interested in?
 - Do you have any organizational experience (board member student faculty, etc.)?

Description of medical leadership if resident is not familiar with the subject.
2. Job specific situations
 - In which work situations do you encounter medical leadership or medical leadership related topics?
 - Could you identify any situations in which you think of yourself as a frontline leader?
 - What kind of virtues should a frontline leader possess?
 - Do you ever notice work processes which need improvement during your working routines?
3. Evaluation of PIMP programme
 - What did you learn, or what do you expect to learn, from the PIMP programme? How does this add to your medical training?
 - Could you name any barriers or facilitators for participating in a PIMP session? what kind of struggles did you encounter while effectuating improvement projects? Or what kind of struggles do you foresee in carrying out improvement projects?
4. Characteristics of a good doctor [*questions intended for sub-study*]

- What makes a good doctor?
- What does your education add to the competencies you think you need to possess to become a good doctor?
- Does your education contribute to becoming a frontline leader?
- Does your education provide you confidence for your day to day work as a doctor?

Appendix 4. Topic guide interview programme directors

Introduction: general introduction to research project and aim of the interview

1. Competency based education
 - Is your specialty training programme based on the CanMEDS roles?
 - Do you practice them with your residents in specific, workplace, situations?
 - What are the popular CanMED roles among your residents?
 - What do you consider important skills for frontline leaders?
 - Do you recognize these skills among your residents?
2. Description of medical leadership if programme director (or educator) is not familiar with the subject.
3. Job specific situations
 - What work situations do you associate with frontline leadership? Why are these typical?
 - Do you give feedback to your residents? If so, on which topics? How does this work? Explain. If not, why not? Explain.
 - Do you ever notice work processes which need improvement in your daily work routines?
4. Residency training programme
 - What makes a good doctor? [*question intended for sub-study*]
 - How and what does your educational programme add to the competencies that residents need to become a good doctor?
 - How and what does your educational programme contribute to developing frontline leaders?
 - Does your own medical training provide you confidence for your day to day work as a doctor?
5. Evaluation of the PIMP programme
 - How is the PIMP programme organized in your department?

- What do your residents learn from the PIMP programme? How do you notice this? Or what do you expect them to learn? How will this help them in becoming a good doctor?
- Could you name any barriers or facilitators for resident participation in a PIMP session?
- How many residents attend a PIMP session in your department? (mean)
- What kind of struggles did your residents encounter while effectuating improvement projects? Or what kind of struggles do you foresee in carrying out improvement projects by residents?
- How do you support residents in effectuating improvement projects? Or how do you intend to support residents in effectuating improvement projects?

Appendix 5. Open-ended evaluation form

1. How many PIMP sessions did you attend up till now?
2. What did you expect to learn from the PIMP sessions?
3. Did you ever contribute a PIMP aim? If yes: how many? If no: why not?
4. Were you assigned to an improvement project? If yes: which one? If no: why not?
5. What did you think of the PIMP session in terms of structure, duration and leadership?
6. Did you find the PIMP session was lacking something important? What would you want to change about the Wonder and Improve session?
7. Grade the session on a scale of 1–10.

Appendix 6. Respondent demographics

Respondent study number	Sex	Age	Specialty	Job description	Year of training (total training)	Years of experience as House Consultant
1	Male	34	Neurology	Resident	5(6)	–
2	Male	37	Neurology	House consultant	–	2
3	Female	31	Gastroenterology	Resident	6(6)	–
4	Male	35	Gastroenterology	Resident	6(6)	–
5	Female	29	Internal Medicine	Resident	4(6)	–
6	Female	36	Internal Medicine	Resident	4(6)	–
7	Female	31	Internal Medicine	Resident	3(6)	–
8	Male	50	Gastroenterology	Program Director	–	14
9	Female	28	Internal Medicine	Resident	1(6)	–
10	Female	28	Internal Medicine	Resident	3(6)	–
11	Male	34	Internal Medicine	Resident	5(6)	–
12	Female	32	Internal Medicine	Resident	4(6)	–
13	Female	30	Internal Medicine	Resident	4(6)	–
14	Female	31	Internal Medicine	Resident	4(6)	–
15	Male	31	Neurology	Resident	6(6)	–
16	Male	27	Neurology	House Officer	–	–
17	Male	56	Neurology	Program Director	–	22
18	Female	25	Psychiatry	Resident	1(6)	–
19	Male	57	Psychiatry	Program Director	–	22
20	Female	34	Psychiatry	Resident	2(6)	–
21	Male	42	Surgery	Program Director	–	6
22	Female	33	Internal Medicine	Staff member	–	–
23	Male	32	Paediatrics	Resident	1(6)	–
24	Female	53	Internal Medicine	Program Director	–	23

Appendix 7. Eindhoven Classification Model: medical version [31]

Root cause	Description
Technical factor	<i>External:</i> technical failures beyond the control and responsibility of the investigating organization. <i>Design:</i> failures due to poor design. <i>Construction:</i> correct design which was not followed accurately during construction phase. <i>Materials:</i> rest category for those materials defects not classifiable under technical design or construction.
Organizational factor	<i>External:</i> any failures at an organizational level beyond the control and responsibility of the investigating organization. <i>Transfer of knowledge:</i> refers to failures resulting from inadequate measures taken to ensure that situational or domain specific knowledge or information is transferred to.
Human Behaviour	<i>External:</i> human failures originating beyond the control and responsibility of the investigating organization. <i>Knowledge:</i> the inability of an individual to apply their existing knowledge to manage novel situations. <i>Qualifications:</i> to the incorrect fit between an individual's qualifications, training or education and a task. <i>Coordination:</i> lack of task coordination within the organization or team. <i>Verification:</i> Concerns failures in the correct and complete assessment of a situation including relevant conditions of the patient and materials to be used before starting the intervention. <i>Intervention</i> Applies to failures that result from faulty task planning and execution.
Patient related	<i>Monitoring</i> Pertains to failures during monitoring of process or patient status during or post-intervention.
Other	Failures related to patient characteristics which are beyond the control of staff and influence treatment. Rest category for failures that cannot be classified in any other category.

Appendix 8. Six aims for improving health care as established by the Committee of Quality of Health Care in America [32]

Category	Description
Safe	Avoiding injuries to patients from the care that is intended to help them.
Effective	Providing services based on scientific knowledge to all who could benefit, and refraining from providing services to those not likely to benefit.
Patient-centred	Providing care that is respectful of and responsive to individual patient preferences, needs, and values, and ensuring that patient values guide all clinical decisions.
Timely	Reducing waits and sometimes harmful delays for both those who receive and those who give care.
Efficient	Avoiding waste, including waste of equipment, supplies, ideas, and energy.
Equitable	Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.
Job satisfaction resident	Regarding working-hours, working environment, personal- or work-relations influencing the job satisfaction of residents