University of Groningen

What are the characteristics of excellent physicians and residents in the clinical workplace? A systematic review.

Khawar, Abdullah; Frederiks, Femke; Nasori, Mana; Mak-Van Der Vossen, Marianne; Visser, Mechteld R. M.; van Etten-Jamaludin, Fardi; Diemers, A.D.; van Dijk, Nynke

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Document Version
Publisher's PDF, also known as Version of record

Publication date:
2022

[Link to publication in University of Groningen/UMCG research database](Link)

BMJ Open

What are the characteristics of excellent physicians and residents in the clinical workplace? A systematic review

Abdullah Khawar [ORCID] ,[1,2] Femke Frederiks,[1] Mana Nasori,[1,2] Marianne Mak,[1,3] Mechteld Visser,[1,2] Faridi van Etten-Jamaludin,[4] Agnes Diemers,[5] Nynke Van Dijk[1,2,6]

For numbered affiliations see end of article.

Correspondence to
Abdullah Khawar;
a.a.j.khawar@amsterdamumc.nl

ABSTRACT

Objectives In order to recognise and facilitate the development of excellent medical doctors (physicians and residents), it is important to first identify the characteristics of excellence. Failure to recognising excellence causes loss of talent, loss of role models and it lowers work ethos. This causes less than excellent patient care and lack of commitment to improve the healthcare system.

Design Systematic review performed according to the Association for Medical Education in Europe guideline.

Information sources We searched Medline, Embase, Psycinfo, ERIC and CINAHL until 14 March 2022.

Eligibility criteria We included original studies describing characteristics of excellent medical doctors, using a broad approach as to what is considered excellence. Assuming that excellence will be viewed differently depending on the interplay, and that different perspectives (peers, supervisors and patients) will add to a complete picture of the excellent medical doctor, we did not limit this review to a specific perspective.

Data extraction and synthesis Data extraction and quality assessment were performed independently by two researchers. We used the Quality Assessment Tool for Different Designs for quality assessment.

Results Eleven articles were eligible and described the characteristics from different perspectives: (1) physicians on physicians, (2) physicians on residents, (3) patients on physicians and (4) mixed group (diverse sample of participants on physicians). The included studies showed a wide range of characteristics, which could be grouped into competencies (communication, professionalism and knowledge), motivation (directed to learning and to patient care) and personality (flexibility, empathy).

Conclusions In order to define excellence of medical doctors three clusters seem important: competence, motivation and personality. This is in line with Renzulli's model of gifted behaviour. Our work adds to this model by specifying the content of these clusters, and as such provides a basis for definition and recognition of medical excellence.

INTRODUCTION

Some medical doctors (physicians and residents) are identified as being excellent by their peers, supervisors, teachers or patients. Studying these excellent medical doctors is

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Inclusion of studies with multiple designs and different perspectives to give a complete view on characteristics of excellence in medical doctors.
⇒ Renzulli's model of giftedness appears to be a suitable framework for our results using an existing model of giftedness.
⇒ The term 'excellence' has a wide semantic variance, and as a result, excellence can be differently expressed by different individuals, and assessors may assign different gradients or thresholds to it.

important as it can help in recognising and suitably challenging them throughout their professional development. Failure to recognise excellence is known to cause low morale and prestige among clinicians, suboptimal clinical care, loss of talented clinicians, lack of commitment to improve patient care systems and fewer excellent clinician role models to inspire others.[1] Knowing how excellence is characterised, supervisors and teachers could promote the development of excellent medical doctors, for example, by optimising their learning strategies using the characteristics of excellence.

There is no explicit definition of an 'excellent doctor' in the literature.[2 3] The existing theories on excellence seem primarily aimed at describing excellent (or 'gifted') children and young adolescents.[4 5] Although these theories seem broadly applicable, we do not know whether they also apply to the medical field. However, these models indicate there is more to 'being excellent', as excellence depends on 'above average ability', 'creativity' and 'task commitment' according to Renzulli. Therefore, as a first step to define excellence of medical doctors, we performed a systematic review to identify characteristics of excellence of medical. Assuming that, excellence may be viewed differently depending on the interplay one has with the clinician, and that

BMJ

these different perspectives will add to a complete picture of the excellent clinician, we included different perspectives in this review. We aimed to identify building blocks for a definition on excellence of medical doctors.

METHODS

This systematic review was performed according to the Association for Medical Education in Europe (AMEE) guide to approach systematic reviews and was aligned to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 checklist.[6 7] This review was not registered prior to its start. However, the protocol is available as a supplementary document (see online supplemental appendix 1).

Data sources and searches

We searched Medline (Ovid), Embase (Ovid), Psycinfo (Ovid), ERIC (Ovid) and CINAHL (Ebscohost) for possible eligible studies from the earliest available date for each database. The search strategy was developed in collaboration with an information specialist (FvE-J) and was conducted on 14 March 2022. For the search strategy per database see online supplemental appendix 2.

Terminology

We consider the term 'medical doctors' to encompass 'physicians' and 'residents'. Physicians are all who 'are qualified by education and authorised by law to practice medicine'.[8] Residents, or postgraduate medical trainees, are those who finished medical school, obtained their undergraduate medical degree and practice medicine in any setting (eg, a hospital or primary care setting).[9]

We did not use a definition of excellence, and instead chose to search broadly in the literature.

Study selection

No restrictions were applied concerning publication date, language or geography. Eligibility criteria are listed in table 1.

Table 1 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
1. Describes excellence or synonym of excellence (eg, exceptional, high-achieving or talented) of an individual	1. Excellence was described of only a single competence level (ie, excellent communicators, excellent leaders in healthcare, etc)
2. Describes what makes these individuals an excellent doctor	2. Excellence of an institute/department
3. Describes characteristics of excellence in clinical practice	3. Description of how to become excellent or effect of an intervention on excellence
4. Describes excellence of residents/trainees or medical specialists	4. Researchers view on excellence
5. Original articles	

After deduplication, the studies were uploaded in Rayyan for title and abstract screening,[10] by two independent teams (FF/NVD and AK/MN) labelling each article as either 'include', 'exclude' or 'undecided'. Results were discussed within the two teams. If disagreements in judgement persisted, a third reviewer was consulted. Articles still labelled as 'undecided' would proceed for full text screening. Full texts were obtained to decide on final inclusion. Again, the full texts were screened by two teams (FF/AD/MV and AK/MM) following the same aforementioned procedure.

Data extraction, quality assessment and synthesis

Data extraction was performed by two researchers (FF and AK), using a coding sheet designed for this systematic review, including: (1) author, year, (2) study design, (3) country of origin, (4) participants (specialism), (5) research sample, (6) perspective and (7) characteristics of excellence (see table 2).

Two researchers (AK and MM) independently assessed the quality of the included studies using the Quality Assessment Tool for Different Designs (QATSDD).[11] This tool can be used appraising diverse study designs.[12] It contains a total of 16 items rated on a 4-point scale (0–3) ranging from a total of 0 to 42 for qualitative or quantitative studies, and from 0 to 48 for mixed-methods design. Disagreements were discussed, and if necessary a third reviewer (MV) was consulted.

We produced a synthesis of the characteristics of excellent medical doctors from different perspectives (table 2). This process was iterative and included continuous discussions within our research group. We decided to present the characteristics that stood out most in our results and provide all other characteristics extracted from the studies in table 2.

Patient and public involvement

No patient involvement.

RESULTS

The search yielded 7135 articles: 29 were identified as relevant after initial screening of titles and abstracts and 11 were included after reviewing the full texts (figure 1).[13–23] The included articles were published between 2004 and 2017 with different designs (survey, interview, Delphi method) and from different countries (table 2). We found four different perspectives on excellent medical doctors; (1) physicians on physicians,[13–17] (2) physicians on residents,[18–20] (3) patients on physicians[21 22] and (4) mixed group (diverse sample of participants on physicians).[23] We will describe the characteristics per perspective. The mean QATSDD scores for qualitative studies were 29.8/42,[13 15–20 22 23] for the quantitative study 25/42[21] and for the mixed-method study 35/48.[14] Studies scored low (0 or 1 point) on 'explicit theoretical framework',[13 15 16 18–22] 'sample size considered in terms of

Table 2 General characteristics and data extraction

Author, year	Study design	Country of origin	Participants (specialism)	Research sample	Concerning the excellence of the following group (specialism)	Characteristics of excellence (ranking, percentage or additional explanation when applicable)
Physicians on physicians						
Christmas et al 2008[13]	Interviews	USA	Physicians (Internal Medicine)	n=24	Physicians (Internal Medicine)	Domains that emerged as major features of clinical excellence in academia (% of respondents): ▲ Communication and interpersonal skills (92%) ▲ Professionalism and humanism (88%) ▲ Diagnostic acumen (58%) ▲ Knowledge (42%) ▲ Skillful negotiation of the healthcare system (33%) ▲ Scholarly approach to clinical care (29%) ▲ Other (? %) (ie, comments relating to 'continual reflection on practice of medicine with efforts to improve clinical care' and 'development of systems or processes or measures to improve clinical care' ▲ Passion for clinical medicine (21%)
Eva et al 2011[14]	Survey with closed and open-ended questions	Canada, USA	Physicians (Department of Medicine)	n=282	Physicians (Internal Medicine)	Characteristics of outstanding practitioners (% of reasons provided): ▲ Knowledge (45.1%) ▲ Interpersonal characteristics related to patient interaction (18.7%) ▲ Teaching skills (10.8%) ▲ Research success (6.8%) ▲ Interpersonal characteristics related to interactions with clinical team members (5.8%) ▲ Other (9.3%) (inquisitive, dedication and thorough)
Mahant et al 2012[15]	Interviews	Canada	Physicians (Paediatrics)	n=13	Physicians (Paediatrics)	What makes an excellent clinician, dominant themes: ▲ Reflective clinical practice ▲ Scholarship ▲ Clinical skills, ▲ Cognitive ability ▲ People skills ▲ High intrinsic motivation ▲ Engagement ▲ Adaptability ▲ Passion for patient care ▲ Humility
Sprung et al 2015[16]	Open-ended survey with ranking	North America, Europe, South America, Australia, Hong Kong, and South Africa (Author: Israel)	Physicians (Intensive Care Medicine)	n=96	Physicians (Intensive Care Medicine)	Ranking of 28 attributes of excellent practitioners, top 10: ▲ Knowledge ▲ Outstanding clinical skills ▲ Communicator ▲ Professional and integrity ▲ Team work ▲ Leadership skills ▲ Outstanding teacher ▲ Commitment ▲ Enthusiasm ▲ Compassionate
Kotwal et al 2017[17]	Interviews	USA	Physicians (Hospital Medicine)	n=26	Physicians (Paediatric Specialists)	Themes relating to clinical excellence in hospital medicine: ▲ Communicating effectively ▲ Having superior clinical judgement ▲ Being organised and efficient ▲ Connecting with patients ▲ Being professional and humanistic ▲ Committing to continued growth and development ▲ Appreciating partnerships and collaboration
Physicians on residents						
Ginsburg et al 2010[18]	Interviews	Canada	Physicians (Internal Medicine)	n=19	Residents (Internal Medicine)	Characteristics most referred to when discussing excellent residents (when compared with problematic residents): ▲ Patient communication ▲ Leadership ▲ Work ethic ▲ Sense of humour, nice person, not artificial, down to earth and impact on staff

Table 2 Continued

Author, year	Study design	Country of origin	Participants (specialism)	Research sample	Concerning the excellence of the following group (specialism)	Characteristics of excellence (ranking, percentage or additional explanation when applicable)
Regehr et al 2012[19]	Phase 1: Interviews Phase 2: Pilot review Phase 3: Ranking of profiles (derived from the interviews)	Canada	Physicians (Department of Medicine)	Phase 1: n=19 Phase 2: n=6 to 9 (not exactly specified) Phase 3: n=14	Residents (Department of Medicine)	16 narrative profiles generated: profile A and H 'Outstanding/excellent/exemplary' Characteristics of profile A: ▲ Has a knowledge base with some gaps, but undergoes significant growth; with growth, he/she applies knowledge effectively to individual cases ▲ Is always on time, does not leave until everything is under control ▲ Knows what is going on, even when things are busy ▲ Is always in control of patient data ▲ Has good organisational skills ▲ Assigns workload effectively (taking into account the limitations of junior residents) ▲ Gives appropriate supervision ▲ Has good interaction with patients (and families): explains things carefully, relates information clearly and comprehensively, has a warm and empathic connection, and comes across as caring and knowledgeable ▲ Communicates well with other house staff, nurses and team members; treats them with respect and is well liked ▲ Takes a keen interest, takes every opportunity to read, learns from cases and asks questions ▲ When he/she does not know the answer, he/she takes initiative to read up on an issue and seems to want to develop his/her understanding of what is going on ▲ Appears excited, curious and enthusiastic ▲ Welcomes challenges and regards difficult clinical problems as learning opportunities, not threats ▲ Exudes warmth and caring for everyone around ▲ Has effective non-verbal communication skills Characteristics of profile H: ▲ Listens well and respectfully to juniors and provides helpful and objective feedback; takes the initiative with juniors (embraces opportunities to teach and provide guidance); and is always available and approachable ▲ Is proactive in anticipating problems concerning patient care ▲ Is prepared to deal with complicated situations calmly and efficiently, assesses effectively difficult cases and prioritises well ▲ Does not have extensive knowledge, but the knowledge is pragmatic and well applied ▲ Connects with patients: he/she is well-rounded and has interests beyond the profession; is interested in patients; and patients feel comfortable ▲ Has a deep sense of responsibility ▲ Can be trusted/relied on (this increases during the rotation) ▲ Knows limits of his/her competences and is not afraid to ask for help ▲ Becomes increasingly sure of him/herself over time; becomes more confident in his/her own judgement ▲ Is the sort of doctor that you would want your family to go to ▲ Gets along with everyone ▲ Has a sense of humour and warm personality

Table 2 Continued

| Author, year	Study design	Country of origin	Participants (specialism)	Research sample	Concerning the excellence of the following group (specialism)	Characteristics of excellence (ranking, percentage or additional explanation when applicable)
Oerlemans et al 2017[20]	Interviews	The Netherlands	Physicians (General Practice)	n=18	Residents (General Practice)	Characteristics of excellent General Practitioner trainees: ▲ Medical expertise: performs well on individual skills and capable of integrating them; and able to select diagnostic/therapeutic tools needed in specific encounters ▲ Able to reflect ▲ Digs deeper into what is really going on with the patient ▲ Listens actively ▲ Does not stop until story is complete ▲ Inquisitive, genuinely interested ▲ Broad social interest in daily life ▲ Development of consistent behaviour: ability to pick up patient cues early in the training programme (= flexible) ▲ possesses empathy
Patients on physicians						
Schattner et al 2004[21]	Questionnaire	Israel	Patients	n=445	Physicians (Not specified)	Most desirable attributes of an excellent physician (% patients): ▲ Experienced (50%) ▲ Respecting patient's preferences (25%) ▲ Informing the patient (36%) ▲ Being up-to-date (28%) ▲ Physician's attentiveness (30%) ▲ Being truthful (28%) ▲ Representing the patient's interests (29%) ▲ Patience of physician (38%)
Anderson et al 2007[22]	Survey	USA	Patients (Primary Care)	n=2917	Physicians (Primary Care)	Qualities for providing a rating of excellence for their physician, having outstanding: Access, communication skills, personality and demeanour, medical care, and follow-up, referrals and care continuity
Mixed group: diverse sample of participants on physicians						
Smith et al 2011[23]	Two-round modified Delphi process: open-ended survey, 1 day focused group interview and discussion workshop with ranking	UK	Tutors, advisors and heads of Schools of Anaesthesia and trainee members (Anaesthesia)	Phase 1: n=45 (consultants n=43, trainees n=2) Phase 2: n=16 (of the 45 initial responders)	Physicians (Anaesthesia)	The 18 most highly ranked attributes of an excellent anaesthetist, top 10: ▲ Knowledge ▲ 'Strives for excellence' ▲ Clinical skills ▲ Innovative/original ▲ Good communicator ▲ Flexible ▲ Leadership ▲ 'Can do' attitude ▲ Judgement ▲ Liked and respected
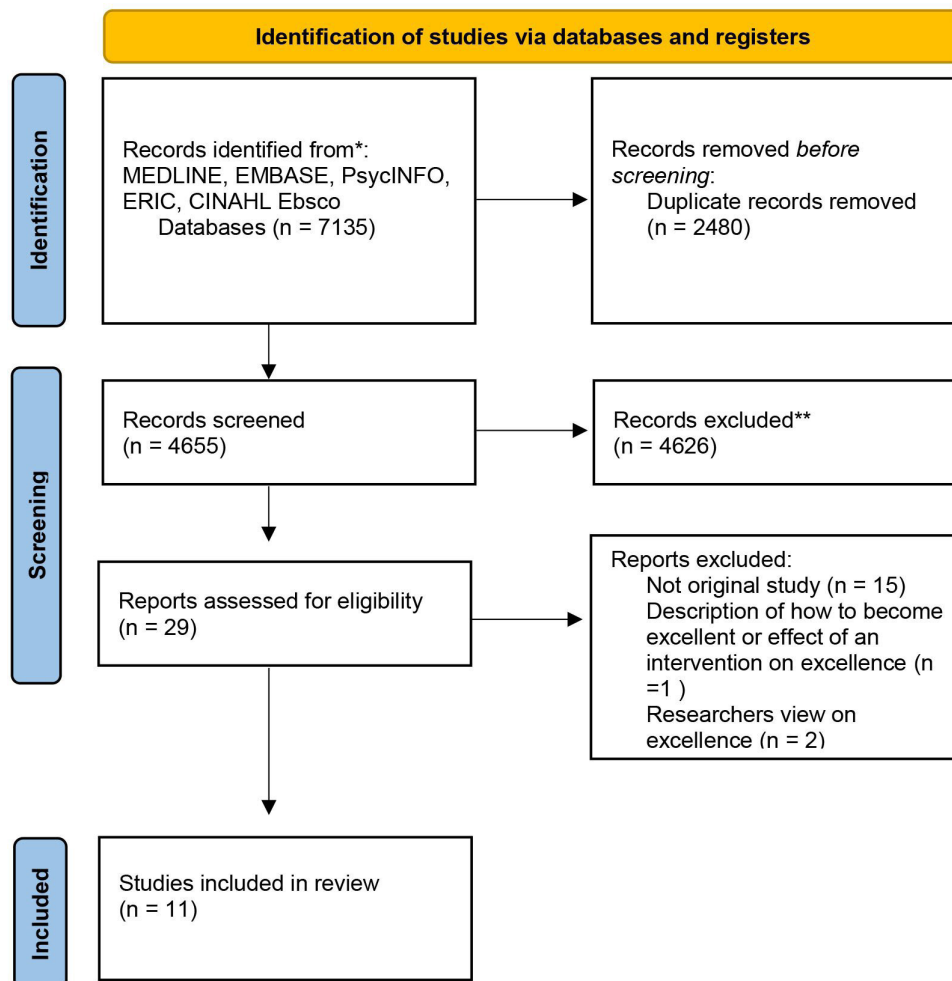
Figure 1 Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram of systematic review selection process.

analysis'[14 16 19 22 23] and 'user involvement in design'[13 16–23] (online supplemental appendix 3).

Many studies described excellence through competencies. And some of these competencies were mentioned across all included studies. We considered some competencies mentioned by the different studies, for example 'Patient communication'[18] and 'communicating effectively'[17] as the same and placed them under the umbrella of 'Communication' according to the CanMEDS framework. In table 2 we provide all data extracted per study.

Physicians on physicians

Christmas et al,[13] Mahant et al[15] and Kotwal et al[17] interviewed physicians who were identified by their peers as being excellent, to identify their characteristics. Eva et al[14] distributed a survey with closed and open-ended questions to identify characteristics of outstanding practitioners. Sprung et al[16] administered a survey in different parts of the world, and subsequently ranked the identified attributes of excellent practitioners.

All studies mentioned competencies as an important characteristic of excellence. The most prominent competencies described in the aforementioned studies were knowledge,[13 14 16 17] communication,[13 16 17]

professionalism[13 16 17] and leadership skills.[13 15 16] Less prominently mentioned competencies were related to research (research success[14] or research skills,[16] and scholarship or scholarly approach[13 15]), being an outstanding teacher[16] and reputation among peers.[13] All articles mentioned a form of motivation (eg, high level of intrinsic motivation,[15] dedication,[14] commitment[16 17] and enthusiasm[16]) as a characteristic of excellence. Besides motivation in general, motivation to learn was specifically mentioned (committed to continued growth and development[17]) as well as motivation for patient care (passion for clinical medicine[13] and passion for patient care[15]). Mahant et al[15] and Sprung[16] et al also mentioned personality characteristics related to excellence: humility,[15] flexibility[15] and empathy.[16]

Physicians on residents

Ginsburg et al[18] interviewed 19 experienced physicians to identify characteristics of excellent residents. Regehr et al[19] created 16 narrative profiles, based on the interviews conducted by Ginsburg et al,[18] and subsequently rated them in multiple phases. The final ranking showed two profiles (profile A and H) categorised as 'outstanding/excellent/exemplary'. Oerlemans et al[20] conducted

interviews with supervisors to identify consistent behaviours of trainees during consultations. Their aim was to develop a framework to describe narrative profiles of perceived behavioural patterns in excellent and underperforming General Practice trainees, to guide future learning and assessment of clinical performance. Two dimensions emerged from these interviews: (1) 'doctor–patient interaction' and (2) 'medical expertise'.

Competencies such as communication,[18–20] knowledge,[18–20] professionalism[18–20] and leadership[18] were important in order to be considered as an excellent resident. Residents were also considered excellent based on their personality characteristics: impact on staff (how the resident affected the staff supervisor, sense of humour and a resident who is fun to work with),[18] a warm personality or exudes warmth[19] and possesses a great deal of empathy.[20] Physicians also mentioned characteristics related to motivation, such as work ethics,[18] genuine interest,[20] appearing excited[19 20] and enthusiastic.[19] Finally, we found aspects related to motivation to learn such as 'wants to develop his/her understanding of what is going on',[19] being inquisitive[20] and being curious.[19 20]

Patients on physicians
Schattner et al[21] asked hospitalised and day clinic patients to select those attributes from a list that they considered the most important and most wanted to see in their own physician. In a qualitative study by Anderson et al,[22] almost 3000 patients rated their physician on several dimensions of healthcare experiences and provided specific comments about aspects of care that were excellent or most in need of improvement.

Both studies mentioned competencies as important characteristics of excellent physicians: medical expert (being an experienced physician[21] and up-to-date[21]) and professionalism (physician's attentiveness,[21] communication,[21 22] demeanour,[22] being truthful,[21] respecting patients preferences[21] and being patient[21]). Schattner et al[21] also specifically mentioned behaviour related to organising care and characteristics of excellence (access, follow-up, referrals and care continuity).

Mixed group (diverse sample of participants on physicians)
Based on a two-round modified Delphi study with medical consultants and trainees, Smith et al described a ranking list of characteristics of an excellent anaesthetist.[23] They identified characteristics of excellent medical doctors related to competencies (clinical skills, knowledge, good communication, show leadership, good judgement) and personality characteristics (being liked, respected, flexible, innovative and original).[23] Finally, the authors mentioned motivation, such as a 'can do' attitude, and striving for excellence.

DISCUSSION
The aim of this systematic review was to identify building blocks for a definition of excellence in medical doctors.

The included studies showed a wide range of characteristics of excellent physicians from four different perspectives. Irrespective of the perspective, characteristics related to competencies were mentioned (medical knowledge,[13–17 19–23] communication[13–20 22 23] and professionalism[13 16 19]). Also, according to the reviewed studies, excellent physicians are motivated, as they are engaged,[15] committed[16] and enthusiastic.[16] Specifically, we found two aspects related to motivation, namely motivation to learn (being able to continuously reflect on the practice of medicine with efforts to improve clinical care[13 15 17 20] and having a high intrinsic motivation[15]) and motivation related to patient care (passion for clinical medicine[13] and for patient care[15]). Also, our results indicate that personality characteristics seem important, such as humility,[15] being empathic,[16 19 20] having a sense of humour[19] and being flexible.[15 20 23]

Our findings feature building blocks for a definition of excellence. Many models exist for defining excellence,[5 24 25] of which Renzulli's is most prominently used.[24] However, these models were directed at defining excellence or gifted behaviour in children. Renzulli defines giftedness, or rather gifted behaviour, as the outcome of the interaction between three clusters of traits: (1) above average abilities, (2) task commitment and (3) creativity. The first cluster is 'above average ability'. Within this first cluster Renzulli distinguishes general abilities (process information, integrate experiences and abstract thinking) and specific abilities (acquire knowledge or perform in an activity). The second cluster is 'task commitment', which he defines as a motivational energy including perseverance, endurance, hard work, self-confidence, perceptiveness and special fascination for a subject. The last cluster is 'creativity', which means fluency, flexibility, originality of thought, openness to experience, sensitivity to stimulations and willingness to take risks. Our findings indicate three clusters of excellence, namely competencies, motivation and personality characteristics, thus our findings have common ground with Renzulli's model.[15 20 23] Additionally, our results seem to be an extension and specification of Renzulli's model, by giving a focused direction towards defining excellence in the medical field. The first cluster, 'competencies in the medical field' is often described using the CanMEDS framework.[26] We did not find new elements or competencies to add to the CanMEDS framework concerning excellent physicians and residents. Our findings show that all competencies were mentioned at least in one of the perspectives. However, some competencies were mentioned most across all studies, and it seems these are considered important competencies belonging to excellent physicians and residents, these included medical knowledge, communication and professionalism. Also leadership (the leader), scientific quality (the innovator) and organisational qualities (the collaborator) were mentioned across different studies. From our data, however, it does not become clear *to what extent* one has to perform within a certain competency, in order to

be considered excellent. Only Oerlemans *et al*,[20] who studied trainees, mentioned that there should be room for growth within competencies. We also found motivation in general (engaged,[15] committed[16] and enthusiastic[16]), and motivation specifically related to learning (eg, being able to continuously reflect on their practice of medicine with efforts to improve clinical care[13 15 17 20]) and related to patient care (eg, passion for clinical medicine[13]). Lastly, also flexibility was recurrently named as a characteristic in the included studies and we also found that medical doctors are judged based on other personality characteristics of which empathy and flexibility[15 20 23] seems a particular interesting one related to patient care. We found personality characteristics, motivation to learn and motivation for patient care. Motivation to learn is an important characteristic in the medical field, as physicians undertake life-long learning activities, also known as continuous professional development, in order to maintain, update or develop their knowledge, skills and attitudes in everyday clinical practice.[27]

Perspectives on excellent medical doctors

There are similarities between the four different perspectives. Patients and physicians both value medical expertise, communication and professionalism. This finding is in line with previous research performed by Price *et al*,[28] who showed that several qualities such as clinical judgement, being up-to date, communication and professionalism were mentioned by medical and non-medical respondents. There are, however, also differences between the perspectives, as patients mentioned only organisational skills, while physicians also mentioned leadership, scientific qualities and teachings skills to judge the excellence of other physicians. Furthermore, physicians mentioned motivation to learn (eg, reflection on clinical practice, scholarship, engagement and commitment to continued growth and development), which was not mentioned by patients. Another difference between the patient and physician perspective is that medical specialists considered residents to be excellent based on their impact on staff (how the resident affected the staff supervisor, sense of humour, being fun to work with)[18] and their warm personality. These differences arise because it can be argued that one is only able to recognise and mention characteristics of excellence that are visible from one's position. Thus, when trying to identify excellent professionals, opinions should be sought from multiple stakeholders as different assessors can identify different characteristics and contribute to a holistic view.

Strength and limitations

The strength of our review is the inclusion of studies with multiple designs and different perspectives to give a complete view on excellence in medical doctors. Furthermore, we tried to explain our finding by using an existing model of excellence. However, this review also has limitations.

The term 'excellence' has a wide semantic variance and as a result excellence can be differently expressed by different individuals, and assessors may assign different gradients or thresholds to it. Because of the wide semantic variance, we may have missed articles in our review. Also because of the wide semantic variance, some of the articles found through the search described clinical excellence as an outcome related to patient care, rather than excellence related to the performance of a physician. While this could be a limitation, in view of our broad search strategy, however, we consider this unlikely. It is remarkable, however, that we did not find studies from the nursing perspective. As multiple perspectives can identify different characteristics and contribute to holistic view on excellence. Another limitation of this study is the variable quality of the included studies. Two studies had less than half of the total amount of points on the QATSDD. Even though we found many characteristics attributed to excellence, from this work it does not become clear *to what extent* a physician should perform within a certain characteristic. For instance, within a competency, whether it is sufficient to be above average, good or really excellent. Neither is it clear if you should possess all competencies to a high extent or if a selection would be sufficient. This also applies to the other characteristics, and asks for further research. Finally, we did not look at the grey literature in this systematic review.

Recommendations and future research

Our work indicates that excellence of medical doctors is related to competencies, motivation and personality. Interestingly, a few of the included studies mentioned motivation to learn when describing excellent medical doctors. Perhaps, excellent medical doctors may be more adapted to optimally benefit from the clinical workplace as learning environment[29] and also engage in deliberate training for practice,[30] thus being 'active learners'. Future research should shed light on the learning characteristics and (environmental) preconditions of excellence, which might result in the development of methods for optimising learning in the clinical setting, talent recognition and facilitate the development of excellent physicians. This understanding might give us insight in the barriers and facilitators of talent development, for those who do possess certain talent(s), but have not yet been stimulated to further develop it. Also, studying to what extent a medical doctor should perform within a certain competency and whether some competencies are more important than others, seems an interesting aspect for further research. Finally, future research should shed light on which didactical improvements and possible recommendations for training excellent medical doctors are suitable, in order to help supervisors (teachers and trainers) to suitably challenging excellent medical doctors in their professional development.

Conclusion

We tentatively conclude that in order to define excellence of medical doctors, the competencies 'knowledge',

'communication' and 'professionalism' are crucial. Furthermore, motivation related to patient care and learning, with an emphasis on motivation to learn as physicians engage in life-long learning activities. Also, personality characteristics seem important, such as flexibility and empathy. These findings are in line with Renzulli's 'three-ring model of giftedness' and add to his work by specifying it for the excellent medical doctors. By providing building blocks for a definition of excellence we took a step towards talent recognition and facilitating the development of excellent physicians.

Author affiliations
[1]Department of General Practice, Amsterdam UMC, Locatie AMC, Amsterdam, the Netherlands
[2]Amsterdam Public Health, Personalized Medicine and Quality of Care, Amsterdam, the Netherlands
[3]Amsterdam Public Health, Personalized Medicine and Methodology, Amsterdam, the Netherlands
[4]Research Support; Medical Library, Amsterdam UMC, Amsterdam, the Netherlands
[5]Faculty of Medical Sciences, Lifelong learning, Education & Assessment Research Network (LEARN), University Medical Centre Groningen, Groningen, Netherlands
[6]Amsterdam University of Applied Sciences, Faculty of Health and Faculty of Sports and Nutrition, Center of Expertise Urban Vitality, Amsterdam, Netherlands

Contributors AK, FF, MV, AD and NvD designed the study. FvE-J developed and performed the search. AK, FF, NvD, ADD, MN and MM screened the search results. AK, FF, NvD and MN extracted the data. AK and MM assessed the quality of the articles. AK drafted the manuscript with input from FF, MM, MV, AD and NvD. All authors critically assessed and contributed to the manuscript revisions, approved this version of the manuscript to be submitted for publication and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work is appropriately investigated and resolved. NvD is guarantor for the content of this systematic review.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting or dissemination plans of this research.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. All necessary data are provided in this manuscript or available in the supplementary data.

ORCID iD
Abdullah Khawar http://orcid.org/0000-0002-5440-9587

REFERENCES
1 Durso SC, Christmas C, Kravet SJ, *et al*. Implications of academic medicine's failure to recognize clinical excellence. *Clin Med Res* 2009;7:127–33.
2 Schnelle C, Jones MA. Protocol for a qualitative study on doctors' opinions on and experiences of exceptionally good doctors. *Adv Med Educ Pract* 2022;13:103–9.
3 Paans W, Wijkamp I, Wiltens E, *et al*. What constitutes an excellent allied health care professional? A multidisciplinary focus group study. *J Multidiscip Healthc* 2013;6:347–56.
4 Türkman B. The evolution of the term of giftedness & theories to explain gifted characteristics. *Journal of Gifted Education and Creativity* 2020;7:17–24.
5 Gagné. Building gifts into talents: detailed overview of the DMGT 2.0 2009.
6 Sharma R, Gordon M, Dharamsi S, *et al*. Systematic reviews in medical education: a practical approach: AMEE guide 94. *Med Teach* 2015;37:108–24.
7 Page MJ, McKenzie JE, Bossuyt PM, *et al*. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71.
8 Wojtczak A. Glossary of medical education terms: part 3. *Med Teach* 2002;24:450–3.
9 Weggemans MM, van Dijk B, van Dooijeweert B, *et al*. The postgraduate medical education pathway: an international comparison. *GMS J Med Educ* 2017;34:Doc63.
10 Ouzzani M, Hammady H, Fedorowicz Z, *et al*. Rayyan-a web and mobile app for systematic reviews. *Syst Rev* 2016;5:210.
11 Sirriyeh R, Lawton R, Gardner P, *et al*. Reviewing studies with diverse designs: the development and evaluation of a new tool. *J Eval Clin Pract* 2012;18:746–52.
12 Harrison R, Jones B, Gardner P, *et al*. Quality assessment with diverse studies (QuADS): an appraisal tool for methodological and reporting quality in systematic reviews of mixed- or multi-method studies. *BMC Health Serv Res* 2021;21:144.
13 Christmas C, Kravet SJ, Durso SC, *et al*. Clinical excellence in academia: perspectives from masterful academic clinicians. *Mayo Clin Proc* 2008;83:989–94.
14 Eva KW, Lohfeld L, Dhaliwal G, *et al*. Modern conceptions of elite medical practice among internal medicine faculty members. *Acad Med* 2011;86:S50–4.
15 Mahant S, Jovcevska V, Wadhwa A. The nature of excellent clinicians at an academic health science center: a qualitative study. *Acad Med* 2012;87:1715–21.
16 Sprung CL, Cohen R, Marini JJ. The top attributes of excellence of intensive care physicians. *Intensive Care Med* 2015;41:312–4.
17 Kotwal S, Peña I, Howell E, *et al*. Defining clinical excellence in hospital medicine: a qualitative study. *J Contin Educ Health Prof* 2017;37:3–8.
18 Ginsburg S, McIlroy J, Oulanova O, *et al*. Toward authentic clinical evaluation: pitfalls in the pursuit of competency. *Acad Med* 2010;85:780–6.
19 Regehr G, Ginsburg S, Herold J, *et al*. Using 'standardized narratives' to explore new ways to represent faculty opinions of resident performance. *Acad Med* 2012;87:419–27.
20 Oerlemans M, Dielissen P, Timmerman A, *et al*. Should we assess clinical performance in single patient encounters or consistent behaviors of clinical performance over a series of encounters? A qualitative exploration of narrative trainee profiles. *Med Teach* 2017;39:300–7.
21 Schattner A, Rudin D, Jellin N. Good physicians from the perspective of their patients. *BMC Health Serv Res* 2004;4:26.
22 Anderson R, Barbara A, Feldman S. What patients want: a content analysis of key qualities that influence patient satisfaction. *J Med Pract Manage* 2007;22:255–61.
23 Smith AF, Glavin R, Greaves JD. Defining excellence in anaesthesia: the role of personal qualities and practice environment. *Br J Anaesth* 2011;106:38–43.
24 Renzulli JS. What makes giftedness?: reexamining a definition. *Phi Delta Kappan* 1978;92:81–8.
25 Gagné F. Motivation within the DMGT 2.0 framework. *High Ability Studies* 2010;21:81–99.
26 Frank JR. *The CanMEDS 2005 physician competency framework*. Ottowa: The Royal College of Physicians and Surgeons of Canada, 2005.
27 Singh T. Continuing professional development of doctors. *Natl Med J India* 2017;30:89–92.
28 Price PB, Lewis EG, Loughmiller GC, *et al*. Attributes of a good practicing physician. *J Med Educ* 1971;46:229–37.
29 Zimmerman B. Chapter 2: attaining self-regulation. A social cognitive perspective. In: *Handbook of self-regulation*. Academic Press, 2000.

30 Mylopoulos M, Lohfeld L, Norman GR, *et al*. Renowned physicians'
    perceptions of expert diagnostic practice. *Acad Med* 2012;87:1413–7.

Protocol systematic review – Project Talent version 6 (09-11-2021)

(Provisional) title: Characteristics of high achieving medical professionals in the clinical workplace, a systematic review.

University of Amsterdam, November 2021.

Authors:

A.A.J. Khawar, F. Frederiks, M. Nasori, N. van Dijk, F.S. Jamaludin, A.D. Diemers, M.R.M. Visser

University of Amsterdam, Department of General Practice.

- Drs. A.A.J. Khawar, PhD-student and resident
  e-mail: a.a.j.khawar@amsterdamumc.nl
- Drs. F. Frederiks, PhD-student and resident.
  e-mail: f.frederiks@amc.uva.nl
- Prof. dr. N. van Dijk, Professor Education and Training and Principal Investigator.
  e-mail: n.vandijk@amc.uva.nl
- Dr. M.R.M. Visser, Senior investigator
  e-mail: m.r.visser@amc.uva.nl
- F.S. Jamaludin, information specialist /clinical librarian
  e-mail: f.s.vanetten@amsterdamumc.nl
- Mana Nasori MSc, Research assistant
  e-mail: m.nasori@amsterdamumc.nl

University Medical Centre Groningen, Department of General Practice.

- Dr. A.D. Diemers, Head of Education and Training
  e-mail: a.d.diemers@umcg.nl

1

1. <u>Introduction</u>

After six years of training, young medical students become doctors, and some, after additional training, become medical specialist. Their training takes place in the clinical workplace (workplace-based learning). Learning in the clinical workplace is different from formal (classroom) education as it is not a controlled setting, but a complex environment in which the primary aim is to provide health care to patients. Learning in the clinical workplace is more informal and dependent on the learning opportunities as offered by the patient mix presented to the practice. However, it is possible to take advantage if medical professionals actively organize their learning process (1-3).

Most residents reach an average level of competence and maintain this level for the rest of their careers (4). Some of these residents, in our experience, take more advantage of this workplace-based learning environment than others, and are therefore could be identified as high-achieving or excellent medical professionals by their peers, trainers and teachers based on their performance in clinical practice (5-7). A definition of clinical excellence is 'achieving distinction in six areas as they relate to patient care', including communication and interpersonal skills, professionalism and humanism, diagnostic acumen, skillful negotiation of the healthcare system, knowledge, scholarly approach to clinical practice, and 'exhibiting a passion for patient care' (8, 9). Perhaps, these high achieving medical professionals, may be more adapted to workplace-based learning than their peers, specifically when looking at their self-regulation, in terms of adjusting their behavior, the environment and their cognitive and affective states to optimally benefit from the workplace as learning environment (10) and also deliberately training for practice (7).

There are several reasons why better understanding into characteristics of high achievers is needed among clinical medical professionals. First, we need to know how to identify these individuals in order to acknowledge them. This is important, as failure to recognize clinical excellence can cause

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

low morale and prestige among clinicians, less than excellent clinical care, loss of talented clinicians, lack of commitment to improve patient care systems, and fewer excellent clinician role models to inspire others (11). Second, by studying the characteristics of high-achieving or excellent medical professionals, more insight can be obtained in methods and preconditions for effective self-regulated learning in the workplace. This understanding might result in the development of methods for optimizing the workplace-based learning.

Although more attention has been paid to characteristics of excellence among clinical medical professionals in recent years (5-7), to our knowledge, no systematic overview of such characteristics is available. Therefore, we will perform a systematic review to identify characteristics of excellence among clinical medical professionals (i.e., residents and specialists) from different perspectives (i.e., those of peers, supervisors, and patients). This is systematic review is a first step in order to understand clinical excellence.

2. **Methods**

Eligibility criteria

For this literature review, no restrictions will be applied concerning publication date, language and geography.

The following inclusion criteria will be used: 1) Describes characteristics of excellence in clinical practice, 2) Describes excellence or synonym of excellence (e.g., exceptional, high-achieving or talented), 3) Characteristics concern more than one competence or skill, 4) Excellence among medical professionals: interns/graduate medical students, residents/postgraduate medical students or medical specialists, 5) Describes excellence from the perspective of coworkers, supervisors, medical students or patients, 6) Original study, and 7) qualitative and quantitative study designs.

3

Studies will be excluded based on the following criteria: 1) Describes characteristics of excellence of anything other than clinical practice or it is unclear whether the characteristics relate to clinical excellence, 2) Excellence in one competence or skill, 3) Excellence of other professionals or undergraduate medical students, 4) Excellence based on authors' predefined criteria, 5) Article concerns predictive characteristics of excellence, acquisition of excellence, or development of excellence

Information sources

We will use Medline (PubMed), Embase (Ovid), Psycinfo, ERIC (Ebscohost) and CINAHL (Ebscohost) from the earliest available date for each database. These are specifically chosen because of the relevance for education in the clinical context, and their focus for the field of medicine in general.

Search strategy

A search strategy for the systematic review will be developed by a clinical librarian (F.S.v.E.-J.), in consultation with the authors. After consensus about the search strategy the clinical librarian will conduct the search. Search terms included in the search, combinations or related words, will be as follows:

Set 1 (population): postgraduate trainees / residents, medical specialists.

Set 2 (location): hospital, general practice, other (primary) care setting.

Set 3 (outcome): excellence, high achieving, giftedness, talent.

Core articles that need to be included in the search (7, 11-18).

4

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

Selection process

After deduplication, the articles identified from the search will be uploaded in Endnote, and subsequently in Rayyan for the title and abstract screening. The title and abstract screening will be performed by four independent screeners (F.F. and N.v.D., A.A.J.K, and M.N.). All articles published until 2017 will be independently reviewed by F.F. and NvD., A.D.D. and M.R.V. will be consulted when disagreement occurs, and articles published after 2017 will be independently screened by A.A.J.K. and M.N., and M.R.V. will be the third reviewer. The independent reviewers will label each article: include, exclude or undecided. Afterwards, the results will be compared and a discussion will take place. If disagreements persist, the third independent reviewer will be consulted. Articles still labeled as 'undecided' will proceed for full text screening. After the initial selection, full text of the included publications will be obtained to decide on final inclusion. If full texts are missing, the authors will be contacted to obtain the full texts. The full texts will be screened by the same reviewers independently and labelled: included, excluded or undecided. Again, articles on which there is no consensus will be discussed with the research team. In case that there is persisting disagreement about the relevance of the articles one of the other reviewers will be consulted as an independent third reviewer.

Data extraction process

The data extraction will be performed independently by two principal reviewers (F.F. and A.A.J.K.), using a coding sheet designed especially for this systematic review (coding sheet not yet available). The other reviewers (divided among N.v.D., A.D.D., M.R.V. and M.N.) revise the selected articles and the extracted data. Information extracted from the articles: 1) Study year, 2) Study design, 3) Country of origin, 4) Participants: occupation and field if applicable (resident / medical specialist), number/volume of study, known personal characteristics of the participants, why are they high achieving?, 5) Perspective(s) if present: who is/are judging who.

5

Quality assessment

The quality will be scored independently by two reviewers (A.A.J.K. and M.N.) using the Quality Assessment Tool for Studies with Diverse Designs (QATSDD) (19). This tool has a strong reliability and validity and it can be applied when appraising diverse study designs (20). In case of disagreement a decision will be reached after discussion. In case of persisting disagreement a third reviewer (M.R.V.) will be consulted. No article will be excluded based on the quality, but instead we will let the quality weigh in the discussion.

Data analysis

Firstly, the data will be analyzed per occupation group (residents or medical specialists). The presentation of the data is dependent on the articles we found.

3. Ethical approval

Not applicable.

4. References used in this protocol

1.   Sagasser MH, Kramer AWM, van der Vleuten CPM. How do postgraduate GP trainees regulate their learning and what helps and hinders them? A qualitative study. Bmc Med Educ. 2012;12.
2.   de Jong J, Visser M, Van Dijk N, van der Vleuten C, Wieringa-de Waard M. A systematic review of the relationship between patient mix and learning in work-based clinical settings. A BEME systematic review: BEME Guide No. 24. Med Teach. 2013;35(6):E1181-E96.
3.   de Bever S, van Rhijn SC, van Dijk N, Kramer A, Visser MRM. Professionals' perspectives on factors affecting GP trainees' patient mix: results from an interview and focus group study among professionals working in Dutch general practice. Bmj Open. 2019;9(12).
4.   Moulaert V, Verwijnen MG, Rikers R, Scherpbier AJ. The effects of deliberate practice in undergraduate medical education. Med Educ. 2004;38(10):1044-52.
5.   Eva KW, Lohfeld L, Dhaliwal G, Mylopoulos M, Cook DA, Norman GR. Modern conceptions of elite medical practice among internal medicine faculty members. Acad Med. 2011;86(10 Suppl):S50-4.
6.   Mahant S, Jovcevska V, Wadhwa A. The nature of excellent clinicians at an academic health science center: a qualitative study. Acad Med. 2012;87(12):1715-21.
7.   Mylopoulos M, Lohfeld L, Norman GR, Dhaliwal G, Eva KW. Renowned physicians' perceptions of expert diagnostic practice. Acad Med. 2012;87(10):1413-7.
8.   Christmas C, Kravet SJ, Durso SC, Wright SM. Clinical excellence in academia: perspectives from masterful academic clinicians. Mayo Clin Proc. 2008;83(9):989-94.
9.   Wright SM, Kravet S, Christmas C, Burkhart K, Durso SC. Creating an academy of clinical excellence at Johns Hopkins Bayview Medical Center: a 3-year experience. Acad Med. 2010;85(12):1833-9.

6

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

10.   Zimmerman B. Attaining self-regulation. A social cognitive perspective. Chapter 2 in: Handbook of Self-Regulation: Academic Press; 2000.

11.   Durso SC, Christmas C, Kravet SJ, Parsons G, Wright SM. Implications of academic medicine's failure to recognize clinical excellence. Clin Med Res. 2009;7(4):127-33.

12.   Murthy VK, O'Brien B, Dhaliwal G. An Inquiry Into the Early Careers of Master Clinicians. J Grad Med Educ. 2018;10(5):500-6.

13.   Christmas C, Kravet SJ, Durso SC, Wright SM. Clinical excellence in academia: Perspectives from masterful academic clinicians. Mayo Clinic Proceedings. 2008;83(9):989-94.

14.   Wright SM, Kravet S, Christmas C, Burkhart K, Durso SC. Creating an Academy of Clinical Excellence at Johns Hopkins Bayview Medical Center: A 3-Year Experience. Acad Med. 2010;85(12):1833-9.

15.   Mahant S, Jovcevska V, Wadhwa A. The Nature of Excellent Clinicians at an Academic Health Science Center: A Qualitative Study. Acad Med. 2012;87(12):1715-21.

16.   Sprung CL, Cohen R, Marini JJ. The top attributes of excellence of intensive care physicians. Intensive Care Med. 2015;41(2):312-4.

17.   Sprung CL, Cohen R, Marini JJ. Excellence in Intensive Care Medicine. Crit Care Med. 2016;44(1):202-6.

18.   Kotwal S, Pena I, Howell E, Wright S. Defining Clinical Excellence in Hospital Medicine: A Qualitative Study. J Contin Educ Health Prof. 2017;37(1):3-8.

19.   Sirriyeh R, Lawton R, Gardner P, Armitage G. Reviewing studies with diverse designs: the development and evaluation of a new tool. J Eval Clin Pract. 2012;18(4):746-52.

20.   Harrison R, Jones B, Gardner P, Lawton R. Quality assessment with diverse studies (QuADS): an appraisal tool for methodological and reporting quality in systematic reviews of mixed- or multi-method studies. BMC Health Serv Res. 2021;21(1):144.

Supplemental Digital Appendix 2. Search strategy in MEDLINE, EMBASE, PsycINFO. ERIC via Ovid, and CINHAL (Ebsco).

MEDLINE (OVID):

#	Searches
1	"Internship and Residency"/
2	Achievement/
3	(highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance).ti,ab,kw.
4	2 or 3
5	1 and 4
6	((clinician* or physician* or trainee* or medical specialist* or graduate* or postgraduate* or intern or interns or residen* or hospitalist* or practitioner*) adj9 (highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance)).ti,ab,kw.
7	(exceptional professional* or outstanding professional*).ti,ab,kw.
8	5 or 6 or 7
9	exp Academic Medical Centers/
10	Faculty, Medical/
11	exp Medicine/
12	exp Hospitals/ or exp Patient Care/
13	exp General Practice/ or exp Primary Health Care/
14	(hospital or hospitals or academic medical center* or academic medical centre* or academic health science center* or academic health science centre* or clinical practice or medical faculty or medicine faculty or physician practice or general practice or GP or family practice or primary care or primary health care).ti,ab,kw.
15	9 or 10 or 11 or 12 or 13 or 14
16	8 and 15
17	editorial/ or letter/ or comment/ or exp consensus development conference/ or meta-analysis/ or "systematic review"/ or exp Congresses as Topic/ or (letter* or editorial or comment* or systematic review).ti.
18	16 not 17

1

EMBASE (OVID):

#	Searches
1	resident/
2	exp achievement/
3	(highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance).ti,ab,kw.
4	2 or 3
5	1 and 4
6	((clinician* or physician* or trainee* or medical specialist* or graduate* or postgraduate* or intern or interns or residen* or hospitalist* or practitioner*) adj9 (highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance)).ti,ab,kw.
7	(exceptional professional* or outstanding professional*).ti,ab,kw.
8	5 or 6 or 7
9	exp medicine/
10	exp hospital/ or exp hospital care/
11	general practice/ or primary medical care/
12	(hospital or hospitals or academic medical center* or academic medical centre* or academic health science center* or academic health science centre* or clinical practice or medical faculty or medicine faculty or physician practice or general practice or GP or family practice or primary care or primary health care).ti,ab,kw.
13	9 or 10 or 11 or 12
14	8 and 13
15	editorial/ or letter/ or note/ or "systematic review"/ or exp meta analysis/ or exp conference abstract/ or (letter* or editorial or comment* or systematic review).ti.
16	14 not 15
17	limit 16 to conference abstract status
18	16 not 17

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

PSYCINFO (OVID):

#	Searches
1	medical residency/ or exp physicians/ or clinicians/
2	exp achievement/
3	(highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance).ti,ab,id.
4	2 or 3
5	1 and 4
6	((clinician* or physician* or trainee* or medical specialist* or graduate* or postgraduate* or intern or interns or residen* or hospitalist* or practitioner*) adj9 (highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance)).ti,ab,id.
7	(exceptional professional* or outstanding professional*).ti,ab,id.
8	5 or 6 or 7
9	exp hospitals/ or clinical practice/ or health care services/
10	(hospital or hospitals or academic medical center* or academic medical centre* or academic health science center* or academic health science centre* or clinical practice or medical faculty or medicine faculty or physician practice or general practice or GP or family practice or primary care or primary health care).ti,ab,id.
11	9 or 10
12	8 and 11
13	"systematic review"/ or meta analysis/ or (letter* or editorial or comment* or systematic review).ti.
14	12 not 13

3

ERIC (OVID):

#	Searches
1	physicians/ or graduate students/ or doctoral students/
2	exp achievement/
3	(highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance).ti,ab,id.
4	2 or 3
5	1 and 4
6	((clinician* or physician* or trainee* or medical specialist* or graduate* or postgraduate* or intern or interns or residen* or hospitalist* or practitioner*) adj9 (highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance)).ti,ab,id.
7	(exceptional professional* or outstanding professional*).ti,ab,id.
8	5 or 6 or 7
9	exp hospitals/ or medical school faculty/ or medical services/ or medicine/
10	(hospital or hospitals or academic medical center* or academic medical centre* or academic health science center* or academic health science centre* or clinical practice or medical faculty or medicine faculty or physician practice or general practice or GP or family practice or primary care or primary health care).ti,ab,id.
11	9 or 10
12	8 and 11

4

CINAHL (Ebsco):

#	Searches
1	(MH "Internship and Residency") AND (MH "Achievement" OR (TI (highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance) OR AB (highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance)))
2	TI ((clinician* or physician* or trainee* or medical specialist* or graduate* or postgraduate* or intern or interns or residen* or hospitalist* or practitioner*) N3 (highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance)) OR AB ((clinician* or physician* or trainee* or medical specialist* or graduate* or postgraduate* or intern or interns or residen* or hospitalist* or practitioner*) N3 (highly professional* or excellen* or exceptional* or high achiev* or gifted* or talent* or outstand* or eminent* or expert development or expert performance))
3	S1 OR S2
4	(MH "Academic Medical Centers" OR MH "Hospitals" OR MH "Medicine+") OR (TI (hospital or hospitals or academic medical center* or academic medical centre* or academic health science center* or academic health science centre* or clinical practice or medical faculty or medicine faculty or physician practice or general practice or GP or family practice or primary care or primary health care) OR AB (hospital or hospitals or academic medical center* or academic medical centre* or academic health science center* or academic health science centre* or clinical practice or medical faculty or medicine faculty or physician practice or general practice or GP or family practice or primary care or primary health care))
5	S3 AND S4
6	(MH "Systematic Review") OR ((MH "Congresses and Conferences")) OR TI (letter* or editorial or comment* or systematic review)
7	S5 NOT S7

Supplemental Digital Appendix 3. Quality assessment using QATSDD

Study	Anderson et al., 2007[22]	Christmas et al., 2008[4]	Ginsburg et al., 2010[16]	Mahant et al., 2012[18]	Kotwal et al., 2017[17]	Oerlemans et al., 2017[19]	Smith et al., 2011[20]	Regehr et al., 2012[15]	Sprung et al., 2015[21]	Schattner et al., 2004[23]	Eva et al., 2011[1]
	Qualitative studies									**Qualitative study**	**Mix-method study**
Explicit theoretical framework	1	1	1	1	2	0	2	1	0	0	2
Statement of aims/objectives in main body of report										3	3
Clear description of research setting	2	3	3	3	3	3	3	3	3	3	3
Evidence of sample size considered in terms of analysis	0	3	3	3	3	3	0	0	0	3	0
Representative sample of target group of a reasonable size	1	3	3	3	3	3	2	3	3	3	3
Description of procedure for data collection	2	2	3	3	3	3	3	3	2	2	3
Rationale for choice of data collection tool(s)	1	2	3	3	3	3	2	3	1	1	2
Detailed recruitment data	2	2	3	3	3	3	2	3	2	3	3
Statistical assessment of reliability and validity of measurements tool(s) (Quantitative only)										1	2
Fit between stated research question and method of data collection (Quantitative only)										2	2
Fit between stated research question and format and content of data collection tool (e.g. interview schedule) (Qualitative)	2	2	3	3	3	3	3	3	1		3
Fit between research question and method of analysis	2	2	3	3	3	3	3	3	2	2	3
Good justification for analytical method selected	1	3	3	3	3	3	1	3	1	1	1
Assessment of reliability of analytical process (Qualitative only)	0	1	2	2	3	3	0	2	0		1
Evidence of user involvement in design	0	0	1	2	1	0	0	0	0	0	2
Strengths and limitations critically discussed	1	2	1	3	3	3	0	2	1	1	2
TOTAL	17	29	35	38	39	36	24	32	18	25	35