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A framework for mentoring of medical students: thematic analysis of mentoring programmes between 2000 and 2015

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Abstract A consistent mentoring approach is key to unlocking the full benefits of mentoring, ensuring effective oversight of mentoring relationships and preventing abuse of mentoring. Yet consistency in mentoring between senior clinicians and medical students (novice mentoring) which dominate mentoring processes in medical schools is difficult to achieve particularly when mentors practice in both undergraduate and postgraduate medical schools. To facilitate a consistent approach to mentoring this review scrutinizes common aspects of mentoring in undergraduate and postgraduate medical schools to forward a framework for novice mentoring in medical schools. Four authors preformed independent literature searches of novice mentoring guidelines and programmes in undergraduate and postgraduate medical schools using ERIC, PubMed, CINAHL, OVID and Science Direct databases. 25,605 abstracts were retrieved, 162 full-text articles were reviewed and 34 articles were included. The 4 themes were identified—preparation, initiating and supporting the mentoring process and the obstacles to effective mentoring. These themes highlight 2 key elements of an effective mentoring framework-flexibility and structure. Flexibility refers to meeting the individual and changing needs of mentees. Structure concerns ensuring consistency to the mentoring process and compliance with prevailing codes of conduct and standards of practice.

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Introduction

Mentoring nurtures professional and personal development (Buddeberg-Fischer and Herta 2006; Frei et al. 2010; Hawkins et al. 2014; Irby 1986; Usmani et al. 2011), improves research output (Sethi et al. 2015), enriches educational programmes (Morzinski et al. 1996; Sethi et al. 2015) and boosts recruitment (Dimitriadis et al. 2012a; Sethi et al. 2015). However, heterogeneity amongst mentoring approaches described in the literature inhibit the achievement of consistent mentoring outcomes (Sambunjak et al. 2010).

Actualizing a consistent evidence-based approach to mentoring that would ensure consistent mentoring experiences amongst mentees and nurture effective mentoring relationships that underpin the success of mentoring programs continues to elude mentoring in medicine (Sng et al. 2017). This is contributed by the conflation of mentoring practices with other educational roles like preceptorship, role-modelling, sponsorship, supervision and counselling (Loo et al. 2017; Sambunjak et al. 2010; Sng et al. 2017; Loo et al. 2017; Wahab et al. 2016). Moreover, the various forms of mentoring in medicine such as near-peer, peer, family, leadership, youth, patient mentoring and novice mentoring (mentoring between a senior clinician and a medical student) bear distinctive features, specific goals and particular uses that require them to be considered separately in any proposed mentoring framework (Kashiwagi et al. 2013).

Another confounding factor to the emergence of a consistent mentoring approach in medical training is mentoring's nature (Sng et al. 2017). Recent reviews of mentoring in Internal Medicine suggest that mentoring exhibits evolving, adapting, goal-sensitive, context-specific, mentee-, mentor-, organisation- and relationship-dependent characteristics (henceforth mentoring's nature) that prevent simple comparisons of practice across different sites and specialities (Loo et al. 2017; Sng et al. 2017; Toh et al. 2017; Wahab et al. 2016). This dictates that mentoring processes must adapt to meet the particular needs, goals and requirements of mentees, mentors, host organizations and their relationships they share with one another impeding the development of a consistent approach applicable to different settings, goals and mentoring relationships (Loo et al. 2017; Sng et al. 2017; Toh et al. 2017; Wahab et al. 2016).

Such flexibility also raise concerns about the potential abuse of mentoring relationships and the adequacy of oversight of these mentoring processes (Eby et al. 2000, 2010; Loo et al. 2017; O'Neill 2001; Sng et al. 2017; Toh et al. 2017; Wahab et al. 2016). They also pose a unique challenge in Singapore where mentoring plays an increasingly important role in the curricula of both its British-inspired undergraduate medical schools and US-based postgraduate medical schools (Loo et al. 2017; Sng et al. 2017; Toh et al. 2017; Wahab et al. 2016). This has required clinician educators practicing in both medical schools to provide concurrent mentoring support for medical students from diverse educational backgrounds and facing varied challenges and priorities. Ensuing that overall training goals are met for both groups of medical students in a consistent manner and in compliance with prevailing codes of conduct and standards of practice can be difficult particularly when the needs of undergraduate medical students differ from those of postgraduate students.

The need for this review

Ensuring a consistent approach to mentoring in both Singapore's British-inspired undergraduate medical schools and US-based postgraduate medical schools is key. To do so, this study acknowledges the characteristics of mentoring's nature, the distinctiveness of prevailing mentoring approaches and the dominance of mentoring between a senior clinician and a medical student in local mentoring practice and focuses upon novice mentoring. Novice mentoring is defined as *a dynamic, context dependent, goal sensitive, mutually beneficial relationship between an experienced clinician and junior clinicians and/or undergraduates that is focused upon advancing the development of the mentee* (Loo et al. 2017). In light that mentoring encompasses great heterogeneity in its implementation, and considering mentoring's goal- and context-specific, mentor- and mentee-dependent nature, we limit the scope of this study to the confines of novice mentoring.

It is hoped that a consistent, transparent and efficient approach to novice mentoring will ensure effective oversight of mentoring processes and safeguard against the potential for abuse of mentoring relationships (Ackroyd and Adamson 2015; Straus et al. 2009).

Search strategy

Five authors (JHS, PYY, LK, TYS, AT) to carried out independent searches of guidelines and accounts of novice mentoring published between 1 January 2000 and 31 December 2015 in the ERIC, Embase, Web of Science, PubMed, Cochrane Database of Systematic Reviews, CINAHL, OVID and Science Direct databases. The search terms used included "mentor", "mentoring", "mentorship", "medical students", "medical school" AND "medicine" or their combinations. Included were accounts of UG and PG mentoring in all clinical specialties within the medical school curricula. The authors were guided by the Best Evidence Medical Education (BEME) guidelines for reference (Haig and Dozier 2003) and aided by two librarians. The independent searches were carried out between the 3rd and 15th of August 2017.

Focus was confined to mentoring programmes after 2000 as articles prior to 2000 were found to be more likely to conflate mentoring with other practices (Loo et al. 2017; Sng et al. 2017; Toh et al. 2017; Wahab et al. 2016). The search strategy is featured in Table 1.

Quality assessment of studies

Appraisals of selected articles were performed using the Medical Education Research Study Quality Instrument (MERSQI) and the Consolidated Criteria for Reporting Qualitative Studies (COREQ) (Appendix 1).

Data extraction and analysis

Mentoring's nature makes each mentoring program and relationship unique (Ikbal et al. 2017) making valid comparisons of mentoring practice across different health care systems, disparate clinical settings and diverse goals difficult (Loo et al. 2017; Sng et al. 2017; Toh et al. 2017; Wahab et al. 2016). The presence of multiple variables whose roles, associations and impact remain unclear and a wide range of research methodologies amongst prevailing reports of mentoring programs prevent the use of statistical

Table 1 PICOS

PICOS	Inclusion criteria	Exclusion criteria
Population	Medical students	
Intervention	Description of mentoring programmes in medical school (both undergraduate and postgraduate medical schools) Initiating the mentoring relationship Roles and responsibilities of a mentor Evaluation of the mentoring programme, mentor and the mentee Challenges to the mentoring process and how to overcome them Organisational support and strategies	Mentoring in wet bench research/lab work Clinical teaching, supervision, preceptorship, advisorship
Comparison	Comparisons of mentoring programmes, commentaries, reflective and opinion pieces	
Outcome	Outcomes of mentoring on the mentor and mentee Personal reflections and experiences Evaluation forms and questionnaires Grades and examination outcomes for mentees	
Study design	All study designs included: Commentaries, reflective articles, editorials Descriptive papers Case studies, systemic reviews, comparison papers, cross sectional studies, retrospective and prospective studies	Systemic reviews

pooling and analysis. These considerations coupled with an absence of an a priori framework for mentoring has necessitated the use of Braun and Clarke's approach to thematic analysis (2006, p. 81).

Each reviewer (JHS, PYY, TYS, AT, LK) independently coded the same 10 included articles using Braun and Clarke's (2006) approach to thematic analysis. Codes were constructed from the 'surface' meaning of the data. Semantic themes were identified from 'detail rich' codes on various aspects of the mentoring process. Each author grouped the codes and listed the themes they identified. All the authors discussed the themes they identified online and at face-to-face meetings where the "negotiated consensual validation" approach was employed to achieve consensus upon a framework for coding (Braun and Clarke 2006; Sambunjak et al. 2010). This framework was employed to independently code the remaining articles and the "negotiated consensual validation" approach (Sambunjak et al. 2010) use utilised to forward a list of themes attained through discussions and consensus amongst the authors.

The authors used the BEME Collaboration guide and the STORIES (STructured apprOach to the Reporting In healthcare education of Evidence Synthesis) statement to develop a narrative from the included articles (Frei et al. 2010; Sambunjak et al. 2006).

Results

25,605 abstracts were retrieved, 162 full-text articles were reviewed and 34 articles were included (Fig. 1). A breakdown of the medical specialties described in these 34 articles is enclosed in Table 2.

Thematic analysis of the 6 cross sectional studies, 27 case studies and 1 commentary revealed 4 themes—preparation, initiating and supporting the mentoring process and the obstacles to effective mentoring.

A. Preparation for mentoring

Preparation for mentoring is undertaken by the host organization which oversees, administers and supports the mentoring program. Preparation for mentoring includes structuring the mentoring process, mentor selection and training, mentee briefing and creating a culture conducive for mentoring.

(i) Mentor training and selection

The selection of experienced mentors with proven track records in clinical mentoring improves mentoring experiences and outcomes (Areephanthu et al. 2015; Kalen et al. 2010, 2012; Kalet et al. 2002; Pinilla et al. 2015; Stenfors-Hayes et al. 2010).

Mentoring outcomes are further enhanced by preparing mentors for their roles and responsibilities (Boninger et al. 2010; Fornari et al. 2014a; Kalen et al. 2010, 2012; Lin et al. 2015; Murr et al. 2002; Oelschlager et al. 2011; Pinilla et al. 2015; Stenfors-Hayes et al. 2010; Zier and Coplit 2009). Mentors in nearly 32% of mentoring programmes in Germany (Meinel et al. 2011) and 63% of new US medical schools were received formal training (Fornari et al. 2014a). Mentoring training ranged from providing mentors with information packs describing the mentorship programme (DeFilippis et al. 2016; Hawkins et al. 2014) to participation in workshops and seminars on mentoring, leadership and team building (Boninger et al. 2010;

Fornari et al. 2014a; Kalen et al. 2010, 2012; Lin et al. 2015; Murr et al. 2002; Oelschlager et al. 2011; Pinilla et al. 2015; Stenfors-Hayes et al. 2010; Zier and Coplit 2009).

Oelschlager et al. described monthly faculty development activities including sessions on mentoring, teaching clinical skills and professionalism and giving feedback to keep mentors up-to-date and supported (Oelschlager et al. 2011).

(ii) Mentee preparation

Mentee preparation includes establishing clear mentoring goals with mentors and agreement upon the form and frequency of communication and support that will be provided.

Mentee preparation is also enhanced through briefing and/or mentee training. Fornari et al. reported that 13 of the 14 US medical schools surveyed required mentees to be trained for participation in mentoring (Fornari et al. 2014a). Mentee training ranged from use of information packs (Boninger et al. 2010; Hawkins et al. 2014) to participation in intensive foundation courses (Stewart et al. 2011) carried out by the host organisation.

(iii) Structured programme

(a) The importance of structure to mentoring processes

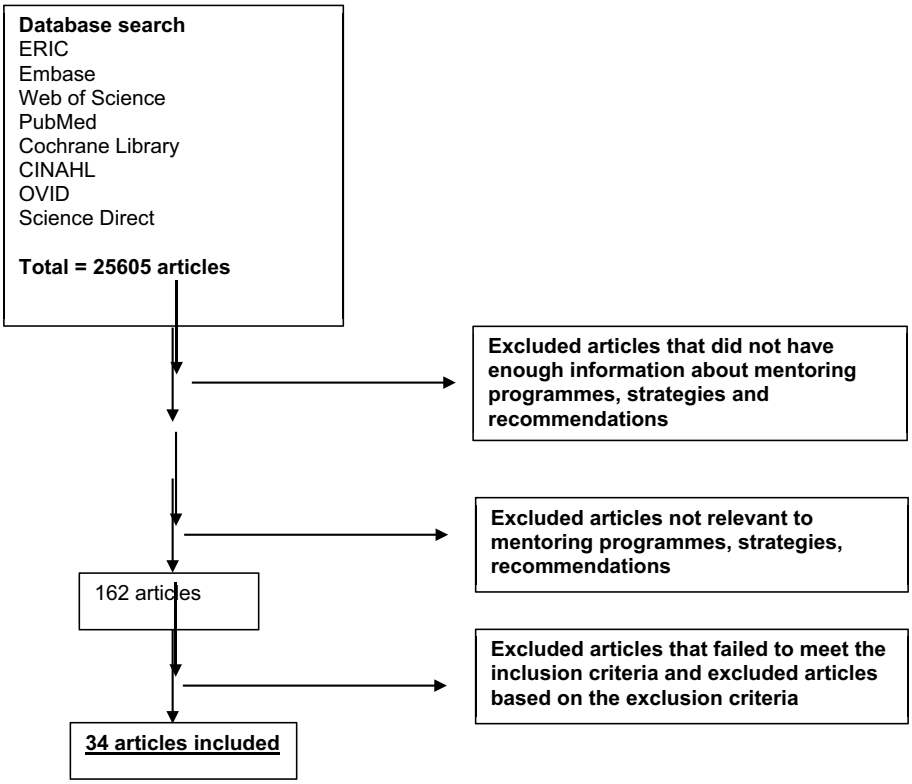

Fig. 1 PRISMA diagram

Table 2 Breakdown of the mentoring programmes reviewed based on specialty

Specialty	Number of papers
Emergency medicine	1
Surgery	2
Neurology	1
Research focused	3
General mentoring not specific to a specialty	27

Structured mentoring programs span the preparatory, initiation and supportive phases of the mentoring process providing orientation programmes, skills training and mentor training, preparing mentees for their mentoring experiences (Dimitriadis et al. 2012b; Fornari et al. 2014a; Meinel et al. 2011; Stanton et al. 2007) and enhancing a mentee's sense of autonomy, connectivity and advocacy (Drolet et al. 2014; Hauer et al. 2005). Structured programs also establish codes of conduct and standards of practice, define the roles and responsibilities of mentees and mentors and stipulate the frequency, duration and form of mentoring meetings (Boninger et al. 2010; Coates et al. 2008) (Dobie et al. 2010; Kalen et al. 2015; Usmani et al. 2011).

Yet perhaps the most significant role of structured mentoring programs lies in its nurturing mentoring relationships, cultivating professional identities, role modelling and longitudinal relationships, fostering a mentoring culture and enhancing mentoring experiences for mentors and mentees through employ of a consistent approach to mentoring interactions and oversight (Boninger et al. 2010; Coates et al. 2008). Most structured mentoring programmes were part of the formal curriculum (Murr et al. 2002; Dobie et al. 2010; Kalen et al. 2015; Usmani et al. 2011).

(b) Mentor to mentee ratio

25 articles discussed mentor to mentee ratios.

One-to-one mentoring

15 papers described one-to-one mentoring relationships. In some accounts mentors had multiple one-to-one relationships. Meinel et al. reported an average of 5.9 one-to-one mentoring relationships (Meinel et al. 2011) and Fornari et al. reported mentors having up to 20 relationships (Fornari et al. 2014b).

Mixed peer and novice mentoring, group mentoring

5 articles described simultaneous use of peer and novice mentoring highlighting significant variances in mentor to mentee ratios. Usmani et al. reported a ratio of 1 mentor to 10 mentees, Lin et al. used a ratio of 1:9 and Kalen et al. reported 1:4. These 3 papers though reported increased peer learning, group sharing and good personal support amongst participants (Kalen et al. 2015; Lin et al. 2015; Usmani et al. 2011).

Von Der Borch et al. described one-to-one mentoring supplemented by 12 students serving as junior mentors in a peer mentoring programme. No reports on the outcomes of this two-tiered mentoring system were provided (von der Borch et al. 2011). Pololi et al. also describes an "innovative collaborative" or peer group mentoring programme, finding

it 'satisfying' and cost-effective (Pololi et al. 2002). DeFilippis et al. found that the combination of novice, near peer and peer mentoring allowed the formation of horizontal and vertical relationships, facilitating professional identity formation (DeFilippis et al. 2016).

These reports suggest that the size and complement of peer groups impacts the type of support provided. Smaller groups were better suited for personalised support and relationship building whilst large groups suited support of professional issues (Kwan et al. 2015).

(ii) Promoting a culture of mentoring

Pinilla et al. reported that lunch conferences and lectures promoted awareness of mentoring, garnered 'political support' and promoted collaboration between departments and personnel (Pinilla et al. 2015). The presence of dedicated mentoring programmes also helped to develop a culture for mentoring that enhanced mentee and mentor recruitment (Coates et al. 2008; Sethi et al. 2015; Stanton et al. 2007).

B. Initiating mentoring

The primary goal of the initiation process is to establish a personal relationship between the mentee and the mentor that will help sustain the relationship in changing conditions and through inevitable challenges. These themes consider the manner in which mentors and mentees are paired (matching):

Matching

13 articles discussed the matching process. Meinel et al. described 3 dominant forms of matching which include allowing mentees to choose their mentors, random assignment of mentors to mentees and matching mentors to mentees based on specific criteria (Meinel et al. 2011).

(i) Mentee initiated mentoring relationships

Boninger et al. described two forms of 'mentee-initiated mentoring relationships' (Boninger et al. 2010). Mentees at Brown University were provided guidance on mentor selection whilst mentees at the University of Pittsburgh were not (Boninger et al. 2010). The impact of guiding mentees in their selection of mentors was not detailed (Boninger et al. 2010).

Pinilla et al. offered mentees the option of selecting a mentor from a preselected group of 10 mentors with similar personal and professional interests. Nearly 88% of 842 mentees chose computer-'matched' mentors to help guide their selection of an appropriate mentor (Pinilla et al. 2015). The impact of this intervention was also not reported (Pinilla et al. 2015).

(ii) Random assignment of mentors

Stanton et al. at Harvard University (Stanton et al. 2007), Coates et al. at the University of California-Los Angeles (Coates et al. 2008), Kalen et al. at the Karolinska Institute (Kalen et al. 2010, 2012), Usmani et al. at Bahria University in Pakistan (Usmani et al. 2011) and Lin et al. at the China Medical University Hospital in Taiwan (Lin et al. 2015) found that

mentees randomly matched to mentors reported increased self-confidence and improved professional and personal development.

Not taking into account specialty inclinations and personal interests, Dobie., Haubert. and Oelschlager et al. described beneficial outcomes of randomly assigned mentoring relationships (Dobie et al. 2010; Haubert et al. 2011; Oelschlager et al. 2011).

(iii) Guided assignment of mentors

Drolet et al. however found that student who were matched to residents based on self-identified professional and personal interests had more positive feelings towards surgeons and surgical careers and reported improved confidence and better clinical exposure (Drolet et al. 2014).

Stanton et al. reported that assignment of mentors to mentees was particularly successful when mentee and mentor shared strong mutual interests (Stanton et al. 2007). Coates et al. found mentees allocated to mentors of the same gender, ethnicity and family status reported better mentoring experiences (Coates et al. 2008).

(iv) Study of various forms of matching

In a survey of 14 'new' medical schools Fornari et al. reported that 7 medical schools allowed students to select their own mentors and 7 schools randomly assigned mentors. The authors did not offer comparisons of the outcomes of these approaches (Fornari et al. 2014a).

C. Supporting the mentoring process

Meinel et al.'s study of mentoring German medical schools described matching in 22 programmes. 10 programmes allowed mentees to choose their mentors, 7 facilitated mentee-initiated relationships by providing online mentoring profiles, 1 used paper -based mentor profiles, 2 programmes used personal interviews and 1 programme used regular 'get together' events to acquaint mentees with potential mentors. 6 of the 12 remaining programmes randomly assigned mentors to mentees whilst the other 6 matched mentors to mentees based on specific criteria. The matching criteria for the various approaches and their outcomes were not stated (Meinel et al. 2011)

Support of mentoring relationships is largely undertaken by the host organization which provides resources and structure to support newly formed mentoring relationships.

Mentoring resources

The provision of administrative and financial support helps mentoring to be sustainable and overcome practical barriers to mentoring.

(i) Administrative support

Administrative support in the form of student assistants, secretaries, non-scientific members of staff (Meinel et al. 2011) and hospital assistants (Lin et al. 2015) is important to

the effective running of the mentoring programme and in supporting mentees and mentors (Pinilla et al. 2015).

(ii) Financial

Financial support for the programme is critical. Meinel et al. reported that 50% of mentoring programmes surveyed received funding from the university, 36% of programmes are funded by tuition fees and 23% programmes used third party funds (Meinel et al. 2011). Pinilla et al. employed 'event-specific sponsors' to fund their mentoring programme (Pinilla et al. 2015) whilst Pololi et al. required department chairs and section heads to allocate formal mentoring time for newly appointed mentors (Pololi et al. 2002).

(iii) Incentives

Whilst Usmani et al. believed that that "mentoring is an altruistic act not undertaken for incentives or any other self-benefit" (Usmani et al. 2011) and Kalen et al. reported that mentors at the University of California-Los Angeles gave their time "without meaningful compensation" (Kalen et al. 2015), other authors found that financial remuneration, academic promotion and formal recognition for mentoring efforts enhanced mentoring efforts (Kalen et al. 2010; Lin et al. 2015). Von Der Borch et al. and Lin et al. noted that recognition for outstanding mentorship increased personal satisfaction and advanced the careers of mentors (Lin et al. 2015; von der Borch et al. 2011).

Fornari et al. found 25% of programmes compensated mentors for their mentoring efforts while some mentoring programmes provided access to institutional facilities and library resources as incentives to mentors (Fornari et al. 2014a). Areephanthu et al. reported use of flexible organisational research funding that provide mentors the freedom to pursue their individual research interests (Areephanthu et al. 2015) whilst Oelschlager et al. reported that 25% of the salary of college mentors were funded by the dean's office as incentive for mentors (Oelschlager et al. 2011).

D Obstacles to effective mentoring

(i) Lack of time

A lack of time and insufficient mentoring compromised appropriate and timely support of mentees (DeFilippis et al. 2016; Murr et al. 2002; Usmani et al. 2011), hampered the maturation of mentoring relationships (Kalen et al. 2015; Lin et al. 2015; Santoro et al. 2010) and impeded the development of professional identities (Kalen et al. 2015; Santoro et al. 2010). Fornari et al. and Pololi et al. noted that 'protected time' helped circumvent this obstacle (Fornari et al. 2014a; Pololi et al. 2002).

(ii) Difficulties with faculty recruitment

5 articles highlighted concerns about faculty recruitment (Drolet et al. 2014; Garmel 2004; Lin et al. 2015; Stanton et al. 2007; Stewart et al. 2011). 3 articles discussed the problems associated with a lack of mentors from different backgrounds to support all mentees

groups (DeFilippis et al. 2016; Kwan et al. 2015; Thomas-Squance et al. 2011). Stanton et al. reported that steering committees could help circumvent this limitation by helping to recruit mentors, supervise the matching process, oversee faculty training and development and conducting programme reviews (Stanton et al. 2007).

(iii) Balance to the structured program

In the effort to standardize mentoring across similar settings, Aagaard and Hauer who reiterate the imperative to maintain flexibility within the mentoring structure to support the various roles and functions of mentors (Aagaard and Hauer 2003).

Discussion

There is a need to balance consistency in mentoring approaches whilst retaining flexibility to meet the individual needs of mentees and mentors across the mentoring journey. The Mentoring Framework derived from the themes identified in this review seeks to ensure that mentoring support is utilised to its full potential whilst being sufficiently flexible to address the changing needs and evolving nature of mentoring relationships within the confines of acceptable practice.

The Mentoring Framework inculcates evidence-based recommendations to bridge gaps in practice and provide consistent guidance across the various phases of the mentoring process. This framework allows for differences in setting, healthcare systems and culture and serves to operationalise an effective program around the key elements of successful mentoring programs.

A framework for mentoring in medical schools

The Mentoring Framework pivots upon 5 pillars: (a) programmatic structure; (b) oversight by a host organization; (c) integrating mentoring with existing medical training curricula; (d) employing a guided matching process; (e) recommendation for mentor and mentee training.

At the heart of this framework is the host organisation, instilling the values, roles and responsibilities of the program, enshrining organisational culture, providing administrative, financial and matching support, overseeing preparation, initiation and support of the mentoring process, and policing compliance of prevailing standards and codes of practice. For universities such as the National University of Singapore which hosts the Duke-NUS Medical School (postgraduate) and the Yong Loo Lin Medical School (undergraduate), the developing number of US medical schools that run premedical programmes in tandem with their established post-graduate programmes and the expanding number of British, Australian and New Zealand universities that offer postgraduate entries to medicine in addition to established undergraduate courses; an effective framework is essential to maintain oversight of the mentoring processes.

The Mentoring Framework proposed here adopts a guided matching process overseen by a host organization to ensure mentees are provided with the best opportunities to select appropriate mentors to build well-supported and ‘safe’ mentoring relationships with that will span their university education and potentially beyond (Table 3).

Table 3 The mentoring framework

1. The Host Organization
The mentoring program should be overseen by a host organization that must invested in the mentoring process providing administrative, financial, educational and research support to the program along with incentives and recognition for mentors and mentees. Critically the host organization should build and oversee the mentoring program and address obstacles to effective mentoring
The host organization should support effective communication between mentees and mentors and appropriate evaluation of the program
2. Clear goals and focus of the mentoring program
Potential mentees and mentors should be aware of the scope and focus of the mentoring program, have access to the curriculum information, timelines and time commitments for the program and the expectations, codes of conduct and the standards of practice that they will be held to. This will aid their decisions as to whether to pursue a mentoring relationship. It is clear that mentees and mentors who are informed about what the focus of the mentoring process, the expectations and the ultimate goals of the program fare better. It also helps in the selection process with motivated mentors and mentees more likely to enrol in the program
3. Formal recognition of the mentoring program
Having the mentoring program recognized and supported by a hospital or university department will lend credibility to the program and ensure sustainability, oversight and transparency to the program
4. Structured program
Recruitment, staff retention, support and oversight of the mentoring process is made possible when the mentoring program is structured replete with a clearly stated mentoring approach and support mechanism and is acknowledged within the medical curricula. At the heart of it, the structured program seeks to provide consistency, accountability and transparency to the mentoring process. The structure of the mentoring program allows the host organization to meet many of its roles and responsibilities to the program, mentees and mentors
The structure of the mentoring program however must be flexible enough to cope with the heterogeneous and unpredictable nature of the mentoring relationships within the confines of accepted standards of practice and codes of conduct
5. Mentor Recruitment
Would be mentors with good mentoring track records, good references and motivated to mentor in the clinical settings should be invited to participate in the program
6. Mentors training
All mentors must be briefed on the goals, roles, responsibilities, scope and mentoring approach used in the program. Mentors are trained in communication skills, to appraise the needs of mentees, nurture and develop mentoring relationships and provide timely, individualized, appropriate mentoring support. Mentors may also be trained in research skills for mentoring research projects and providing feedback and be aware of the codes of conduct, practice standards, timelines, communication options and support and feedback mechanisms available to them and to mentees
Mentors should be provided a list of senior mentors whom they can select from to mentor them. Wherever possible new mentors will co-mentor a few mentees with the senior mentor both to be guided and to be provided feedback
7. Near-peer, peer and group mentoring
There is little agreement on the use of near-peer, peer and group (NPG) mentoring nor its role as support for mentors and de facto oversight of individual mentoring relationships
Should NPG mentoring be employed, potential NPG mentors need to be trained on mentoring skills to support and assess mentees, recognize when to escalate issues to the mentor and be provided with mentoring oversight by senior mentors. In addition, NPG mentors must be made aware of the codes of conduct, practice standards, communication options and support mechanisms available for mentees

Table 3 (continued)

The data on the appropriate number of mentees in a group is unclear however this could be determined by data that shows that small groups work best with around 5–8 members (Mills 2013), the focus of the mentoring relationships with professional focused relationships favouring large groups and small groups being better for the provision and nurturing of personal relationships. Other considerations include the mentee's characteristics, abilities, backgrounds and preferences, the mentor's abilities and preferences and the position of the host organization
8. Informal interactions with available mentors
Interested mentees meeting who meet the inclusion criteria for the program should be encouraged to meet potential mentors to foster 'personal connections' which are largely determined by shared interests and goals. This is also an opportunity for mentees to enquire about the program in more detail, discuss the mentoring project for example or to discuss particular support that they require
These occasions also provide a chance for NPG mentors to make contact with would-be mentees and support their selection process and build personal relationships
9. Mentee recruitment
Mentees need to be assed for their motivations, ability, goals, expectations, availability and understanding of the mentoring process and the mentoring program. Their demographics and goals, values, beliefs, interests and expectations should be documented to help the matching process
10. Mentee training
Mentees selected for the program are keen for guidance on mentor selection should be briefed on how to select mentors, the mentor's roles and responsibilities and what to expect from a mentoring relationship. In addition, mentees must be made aware of the codes of conduct, practice standards, timelines, communication options and support mechanisms
11. Matching
Most medical students do not get the opportunities to work closely with senior clinicians and thus establish mentee-initiated mentoring relationships. Matching mentors to mentees circumvents this problem and is more sustainable in larger mentoring programs
Matching should consider the mentees and mentors demographics, backgrounds, interests, values, beliefs, goals and motivations in carrying out the matching processes.
12. Vetted matching
The matching process should be supported by the host organization and mentees should be provided with a pool of approved mentors with similar goals, interests and demographic and sociocultural backgrounds where possible. Personal characteristics of mentors and mentees must be a central consideration in any matching process. Mentees are provided with a list of vetted mentors to select from
13. Establish pre-mentoring meetings
To set expectations, a code of conduct, responsibilities, timelines and the type, frequency and duration of mentoring interactions, pre-mentoring meetings should be established. These decisions agreed upon by mentees and mentors must also lie within the confines of acceptable practice parameters
14. 'Trial period'
Allow mentees and mentors a specified duration to see if they can work together. If this is not possible assess the reasons for the failings and re-match mentees to other mentors
15. Feedback and Evaluation
A critical aspect of a mentee's role is to update the mentor about changes in their circumstances and to provide feedback on their mentoring experiences. This process must necessarily be anonymous and be overseen by the host organization
Mentors trained in providing feedback must be easily accessible to mentees and be able to provide individualised, timely, appropriate and specific feedback and support to mentees.
Mentoring requires regular evaluation to direct and improve mentoring processes and to allow organizations proper oversight over the mentoring relationship. At present, however, there is a lack of consensus in the literature on the best method and approach to mentoring evaluations and current evidence for existing mentoring assessment tools is weak

Table 3 (continued)

16. 'Protected time'
Dedicated time for mentoring helps build relationships, allows regular contact and appraisal of mentees and supports mentoring efforts. This may help determine whether multiple one to one mentoring relationships are feasible and whether NPG mentoring ought to be employed 'time pressed' mentors
17. Monitor progress
Continuous, multisource feedback and reviews of mentoring relationships are critical and must include input from mentors and mentees and be carried out by the host organization and overseen by a senior mentor
Part of this process could include the use of feedback and reflections to the mentor and to the host organization and face-to-face reviews with a senior and independent mentor to review the process and support mentees and mentors
18. Systems based thinking
Whilst there is little data on the mentoring environment that supports and nurtures the mentoring relationships and process, host organizations must consider the environment in which mentoring relationships take place, assessing the influences upon them and the effect that the relationships and the program may have upon the environment

The consistent approach to mentoring, regular reviews, use of reflective diaries and feedback will facilitate oversight and policing of the mentoring processes.

Limitations

There are many areas that are not addressed by either the results of the literature review nor the framework proposed. The manner that mentees and mentors are selected, the content of mentor and mentee training and pre-mentoring meetings, the optimal mentoring approach and means for nurturing personalised mentoring relationships remain unclear.

Similarly, how mentoring relationships response to a dynamic environment and how mentoring environments are created have not been clearly established and require further study. Variability in the capacity for many programs to meet such recommendations also raises questions as to the viability of the Mentoring Framework.

A significant limitation of this study is the presence of a heterogeneity of tools and approaches used to evaluate mentoring programs. Use of Scandura and Ragins's 15-item mentoring questionnaire (Jackson et al. 2003; Lin et al. 2015; Scandura and Ragins 1993), the Mentorship Profile Questionnaire and Mentorship Effectiveness Scale (Dimitriadis et al. 2012a), standardised test scores and publication records (Areephanthu et al. 2015), Mentoring Competency Assessment inventory (Fleming et al. 2013) and surveys based on the Association of American Medical Colleges (AAMC) Graduation Questionnaire (Coates et al. 2008) used in the articles reviewed here provide different often inadequate information on the mentoring process. The heterogeneity in methods used to evaluate mentoring make comparisons across settings difficult (Aagaard and Hauer 2003; DeFilippis et al. 2016; Kalen et al. 2010; Santoro et al. 2010; Stenfors-Hayes et al. 2010; Usmani et al. 2011).

Future research

More work is required to improve prevailing assessment tools and assessment of outcome measures too. Multisource longitudinal studies of mentoring relationships and evaluations of the effects of various factors on the dynamic and evolving nature of mentoring ties need to be carried out. Thus only can the impact of this framework be appropriately analysed.

Greater understanding of the mentoring environment, impact of the evolving nature of mentoring relationships, and the continually changing context upon the mentoring process still require elucidation, as does the curricula that would house such a program.

The future of mentoring in medical school looks promising and the potential for recognition and inculcation of mentoring programs into the formal medical curricula is likely to grow from these efforts. Yet, there is still much to be done and focus must turn to the better understanding of the nature and evolution of mentoring relationships and the dynamic every-changing environment that mentoring exists in.

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Compliance with ethical standards

Conflict of interest The authors declare no conflict of interest in the writing of this paper.

Appendix 1

References	Study details	Intervention	MERSQI score	COREQ score
Pinilla et al. (2015)	Quantitative Case study Single center study at the Ludwig Maximilians-Universität Munich during the 2009–1013 academic year N = 3403 medical students and 399 mentors	Two-tiered program with a peer-mentoring concept for preclinical students and a 1:1-mentoring concept for clinical students aided by a fully automated online-based matching algorithm	8.5	NA
Kalen et al. (2010)	Quantitative Intervention, Post survey Single center study at Södersjukhuset during the 2005–2006 academic year N = 118 students and 101 mentors	Offered a personal mentor for 2 years and followed up via a questionnaire when the mentoring programme was completed	10.5	NA

References	Study details	Intervention	MERSQI score	COREQ score
Kalen et al. (2012)	Qualitative Intervention, post survey N = 12 medical students	Medical students who had finished their two preclinical years and were taking their first clinical course were offered a mentor for 2 years	NA	22
Kalen et al. (2015)	Qualitative Case study, post survey Single study center at the Karolinska Institutet, Sweden N = 16 medical students	Students had combined group and one-to-one mentoring that is given throughout their studies. The mentoring programme was focused on the non-medical skills of the profession and used CanMEDS roles of a physician for students' self-assessment	NA	24
Aagaard and Hauer (2003)	Quantitative Case study, post survey Single center study at the University of California, San Francisco N = 302 students	Two programs provided personal support and career advising	13	NA
Hawkins et al. (2014)	Quantitative and qualitative Intervention, post survey Single center study at the Great Western Hospital in Swindon N = 34	Final year medical students were allocated a junior doctor mentor at the start of their attachments. A questionnaire was conducted at the end of their placement 3 months later	11.5	NA
Drolet et al. (2014)	Quantitative Intervention, pre-and post-survey N = 24 students in the course (100%) and 147 students in the control group (67%) completed the surveys	A preclinical elective in surgery was developed, which served as an organized curriculum for junior medical students to experience surgery through a paired resident-mentorship model	14	NA

References	Study details	Intervention	MERSQI score	COREQ score
von der Borch et al. (2011)	Qualitative and Quantitative Needs assessment, Preliminary survey, focus group and sign-up surveys Single study center at the Ludwig-Maximilians-University (LMU) Munich School of Medicine during the 2007–2008 academic years Focus groups with selected medical students (n = 24) and faculty physicians (n = 22) All students signing up for the individual mentoring completed a survey addressing their expectations (n = 534)	NA	13	19
Stenfors-Hayes et al. (2010)	Qualitative Thematic analysis Single center study at the Södersjukhuset, a Karolinska Institutet teaching hospital N = 83 for questionnaires and N = 10 for focus groups	Participants were involved in a mentor programme at Södersjukhuset, a Karolinska Institutet teaching hospital, aimed to provide the students with a channel into the part of the medical profession not covered by factual knowledge and to discuss topics not covered in the educational programme	NA	18
Dimitriadis et al. (2012a, b)	Qualitative and quantitative Intervention, pre, during and post survey Single center study at the Munich Medical School N = 534 students and 203 mentors	A mentoring program was established at LMU School of Medicine and launched in May 2008	13	NA

References	Study details	Intervention	MERSQI score	COREQ score
Zuzuarregui and Hohler (2015)	Quantitative Case study Students involved in the comprehensive opportunities for research and teaching experience program	To promote medical student interest in an academic career in neurology, a faculty member developed a one-on-one mentorship program in the 2010–2011 academic year based on the issues identified by the International Campaign to Revitalise Academic Medicine From 2010 to 2012, the faculty director initiated an informal process to students entering into neurology with opportunities in clinical research Beginning in the 2012–2013 academic year, the faculty director developed a teaching curriculum for interested students	10	NA
Stewart et al. (2011)	Quantitative Case study Single center study at the Johns Hopkins University School of Medicine N = 124 in its transitional one semester class and N = 119 in its first complete two-semester class	The Longitudinal Ambulatory Clerkship provides first year medical students with their initial exposure to clinical medicine during a 12-month experience consisting of weekly clinic sessions with a practicing physician-mentor (preceptor) and longitudinal experience with a population of patients	13	NA

References	Study details	Intervention	MERSQI score	COREQ score
Pololi et al. (2002)	Quantitative and qualitative Single center study at the Brody School of Medicine at East Carolina University during the 1999–2001 academic years N = 18 faculty members	To facilitate faculty in their career development, the authors implemented and evaluated an innovative collaborative, or peer-group, mentoring program at their medical school. The 80-h Collaborative Mentoring Program spanned 8 months and consisted of an initial three-day session followed by a full-day program once a month for 6 months	9.5	19
Dobie et al. (2010)	Qualitative N = 30 physician mentors Single center study at the School of Medicine, University of Washington, Seattle, Washington	Each mentor is assigned six students at matriculation with gender balance and representation from throughout the five state region; there is no attempt to match specialty or other interests. Mentors then reports their perspectives on mentoring medical students during the third year of the program implementation	NA	26
Areephanthu et al. (2015)	Quantitative Analyses of ICR course enrollment and applications to the PSMRF program of data from all medical students who attended UKCOM between 2007 and 2014	NA	13.5	NA
Boninger et al. (2010)	Qualitative Case study Describing and comparison of scholarly projects between two medical schools namely The University of Pittsburgh School of Medicine and the Warren Alpert Medical School of Brown University	Scholarly projects entail mentored study in a single topic area and may include classical hypothesis-driven research, literature reviews, or the creation of a medically related product	NA	NA

References	Study details	Intervention	MERSQI score	COREQ score
Santoro et al. (2010)	Quantitative Single center study at the Albert Einstein College of Medicine during the 2000–2006 academic years N = 188 individuals	Participants participated in the College of Medicine's Clinical Research Training Program, which is a 2-year training program entails a didactic course of study in statistics, epidemiology, data analysis, research ethics, grant writing, and scientific	10.5	NA
DeFilippis et al. (2016)	Case study Single center study at the Weill Cornell Medical college N = 29 mentors and 58 medical students	To improve mentorship opportunities for female medical students, a pilot mentoring programme for women in medicine was established in the autumn of 2013 at Weill Cornell Medical College	NA	NA
Zier and Coplit (2009)	Quantitative Case study Single center study at the Mount Sinai School of Medicine N = 4 students	The Individual Scholarly Project and Independent Research Experience (INSPIRE) was created to enable fourth-year students to conduct mentored, independent scholarly projects to develop critical thinking skills and intellectual independence. INSPIRE featured weekly sessions in which students shared their progress, heard about the careers of physician scientists, and participated in presentation skills workshops	10.5	10

References	Study details	Intervention	MERSQI score	COREQ score
Coates et al. (2008)	Quantitative Intervention, pre and post study Case study Single center study at the David Geffen School of Medicine at the University of California–Los Angele	Fourth year students underwent a The College Program, where students would affiliate with a network of faculty whose specialties reflected a particular type of thought process. These colleges would serve as the foundation for their curricular program and mentoring needs as they transitioned to their eventual careers	13.5	NA
Hauer et al. (2005)	Qualitative Single center study at The University of California, San Francisco, School of Medicine during the 2001 academic year N = 24 fourth year medical students	NA	NA	21
Kwan et al. (2015)	Quantitative Case study Single center study at the Queen's University School of Medicine during the 2012–2013 academic years N = 115 medical trainees	115 medical trainees attended large- and small-group mentoring sessions lasting 2 h each	8	NA
Kosoko-Lasaki et al. (2006)	Quantitative Case study Dual center study at Creighton University and Wake Forest University N = 130 students	Mentoring program were established in Creighton University and Wake Forest University to assist women and minority students and faculty in being accomplished in their academic pursuits	11	NA
Garmel (2004)	Case study	NA	NA	NA
Fornari et al. (2014a, b)	Quantitative N = 14 medical school	Medical schools had their own mentoring programs. Evaluation was done to compare the development of these mentoring programs	13.5	NA

References	Study details	Intervention	MERSQI score	COREQ score
Usmani et al. (2011)	Qualitative and Quantitative Single center study at the Bahria University Medical and Dental college, Karachi, Pakistan N = 22 mentors	The Bahria University Medical and Dental College (BUMDC) implemented a structured mentorship programme since the foundation of college. There are 200 students of first and second year MBBS; thus the mentor mentee ratio is approximately 1:10	13.5	NA
Kalet et al. (2002)	Case study Involves students during the first two years of medical school N = 78	Student-mentoring program is to advance the professional development of our students during the first 2 years of medical school through regular group meetings with skilled, trained faculty facilitators The Master Scholar Program features five theme-based societies composed of students and faculty who share interests in the theme. The themes are for examples bioethics/human rights, health policy/public health, arts/humanities in medicine, biomedical/health sciences, medical informatics/biotechnology)	NA	NA
Murr et al. (2002)	Case study Single center study at the University of California San Francisco	UCSF has developed a formal structure to advise medical students. A selection committee, chaired by the associate dean of student affairs, appointed five faculty mentors to head advisory colleges. These five colleges serve as the advising and well-being infrastructure for the students	NA	NA

References	Study details	Intervention	MERSQI score	COREQ score
Lin et al. (2015)	Quantitative Intervention, Post study Single center study at the China Medical University Hospital during the 2013–2014 academic year N = 118	China Medical University Hospital (CMUH) redesigned a clinical mentoring program that was first instituted in 2001, aimed at enhancing the learning life of clerks, improve their socialization, and provide counseling services, particularly regarding their clinical learning progress	13	NA
Haubert et al. (2011)	Qualitative and Quantitative Intervention, Pre and Post study Single study center at the Ohio State University College of medicine during the 2008–2009 academic years	Five programs designed to involve surgeons as educators in the medical school curriculum were implemented. The first program, started in 2008, introduced surgical faculty into the first-year medical student anatomy dissection laboratories. Other programs initiated in 2008 included: Surgical Clinical Correlates in Anatomy, which involved faculty teaching through cadaver surgery; Clinical Pathologic Conferences in Anatomy, a surgeon-led conference based on clinical cases; and a women's faculty-student mentorship program. Table Rounds, a surgeon-led anatomy review that used clinical scenarios to quiz students was begun in 2009	12.5	NA

References	Study details	Intervention	MERSQI score	COREQ score
Scheckler et al. (2004)	Case study Single center study at The University of Wisconsin Medical School	The Class Mentor Program at the University of Wisconsin Medical School is a mentorship program of an entire class of students for their full 4 years by a single senior clinician where the Class Mentor dedicates 50% of the time to mentorship efforts	NA	NA
Stanton et al. (2007)	Case study Describe an explicit approach to integration used at Harvard Medical School since 2003 that aims to enhance students' learning in medical school and throughout their medical careers: the Mentored Clinical Casebook Project	The MCCP was implemented at Harvard Medical School (HMS) in 2003. It is a yearlong project in which each participating medical student works with one clinician and one patient. The student spends as much time as possible with the patient in office and hospital appointments and also visits the patient's home. The student, in consultation with his or her mentor, defines all the components of the patient's health situation (including the patient's story, the pathophysiology of the health problem, socioeconomic issues, cultural issues, etc.)	NA	NA

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