The rotational approach to medical education: time to confront our assumptions?

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CONTEXT Trainees in undergraduate and postgraduate medical education engage in multiple transitions as part of the educational process, including many transitions that occur on both periodic and daily bases within medical education programmes. The clinical rotation, based on either a medical discipline or clinical care setting and occurring over a predetermined, short period of time, is a deeply entrenched educational approach with its roots in Abraham Flexner's seminal report. Many assumptions about the presumed benefits of clinical rotations have become pervasive despite a lack of empirical evidence on their optimal timing and structure, and on how transitions between clinical rotations should occur.

METHODS In this paper, we examine the issue of rotational transitions from the three perspectives of sociology, learning theory, and the improvement of quality and safety.

RESULTS Discussion from the sociological perspective addresses the need for much greater attention to interprofessional relationships and professional development, whereas that from the learning theory perspective examines the gap between what is known from pedagogical and cognitive science and what is currently practised (learning theory). Discussion from the perspective of improving quality and safety refers to the critical need to embed trainees in functional clinical microsystems as meaningful participants.

CONCLUSIONS Research is urgently needed on the effects of transitions on trainees, faculty staff, non-doctor health care providers and patients in order to optimise future competency-based training models and confirm or refute current assumptions.

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INTRODUCTION

One hundred years ago, the Flexner report drew attention to the lack of facilities, resources and ideals in medical training.[1] The report placed a specific focus on effective faculty supervision and outcomes, and helped to accelerate the transformation of medical education. However, the Flexnerian revolution also led to greater emphasis on structure and process in training, including curricula grounded in the 'scientific basis of medical practice and clinical experience', and inspired current medical education as a teacher-centred system in which trainees advance as a function of 'dwell' time, simply based on the amount of time spent in a program.[1,2] The rationale for this approach was to ensure that undergraduate and graduate trainees in medicine received sufficient breadth and depth of experience. Flexner envisioned trainees working alongside academic faculty staff in caring for patients and performing clinical research for extended periods in the hospital setting.

As knowledge and technological capability in medicine exploded, medical schools and postgraduate medical education (PGME) programmes adapted by creating an increasingly diverse and greater number of clinical experiences that aligned with the changing design of care delivery. At the time of the Flexner report, the completion of medical school was considered sufficient to prepare the vast majority of individuals to practise medicine. Clearly, this state of affairs has changed dramatically, especially in the last 30 years with the advent of multiple new specialty disciplines and specialised care units inside and outside the hospital.[2–4]

Trainees now move through a series of clinical rotations, beginning in the clinical years of medical school. These transitions in medical school are designed to allow exposure to multiple disciplines and to help guide students in choosing a specialty, and are mandated by accreditation requirements.[5] In postgraduate training, the content focus narrows around a particular discipline, but, somewhat paradoxically, the number and frequency of rotations often increase during specialty training, especially for certain disciplines in the USA, such as internal medicine and paediatrics.[6,7]

The situation is similar throughout the rest of the world. In Canada, for example, the length of rotations varies substantially among specialties, but most PGME rotations in Canada last 4–8 weeks[8,9] (Fig. 1).

As further examples, most medical student clerkship rotations in New Zealand, the UK and Taiwan are 4–8 weeks in length (T Wilkinson, V Wass, M Ho, personal communications, 2010). Rotations in PGME training can range from 1 to 6 months in these countries.

Approximately 10–15 years ago, medical education training worldwide began to embrace competency-based education and training (CBET), an outcomes-based approach that uses competencies to guide curricula and assessment.[10–12] However, the transformation to outcomes-based medical education is causing significant tension within the medical education community and often makes agonisingly slow progress.[13] One likely cause of this tension and slow progress may be that educators are trying to insert competency-based assessments and curricula into a system that is clearly designed to emphasise structure and process, including the use of multiple clinical rotations, over outcomes.

In this issue of *Medical Education*, Teunissen and Westerman provide rich information on the impact of major transitions between stages of a career, such as from medical school to postgraduate training (e.g. residents, registrars) to unsupervised practice.[14] Prior work shows that many doctors will experience further transitions during a practice career, such as by retraining in a new specialty or assuming leadership roles.[15] However, educators should also recognise that trainees experience multiple transitions *within* the educational stages of medical school and postgraduate medical education.

We originally intended to systematically review and describe how these rotational transitions facilitate or impede professional development, and the effects they have on trainees, the individuals they work with and the patients they care for. Unfortunately, very little has been written specifically on the subject of rotational transitions. As a result, this paper will describe some of the key characteristics of current transitions and will examine the potential benefits, harms and unanswered questions from the three perspectives of sociology, learning theory and quality improvement and patient safety. We believe that consideration from these three perspectives should guide much-needed research about how the current rotational model of medical training impacts patients and trainees and whether a major change to this approach is now indicated. Before turning our attention to these three perspectives, we will briefly review the current state of affairs.

KEY CHARACTERISTICS OF CURRENT TRANSITIONS

Figure 1 shows core rotational requirements for Canadian residencies in paediatrics.[9]

Levels of transitions

Substantial heterogeneity in the type and number of transitions exists worldwide. Figure 2 provides a graphic example of the numerous transitions a typical trainee might experience during medical school and residency training in the USA or Canada; this example is typical of internal medicine and paediatrics training. At the first level are the rotations trainees must complete. Note that the frequency of these rotational transitions often increases when trainees become residents. For example, it is common for a resident in a US internal medicine programme to experience 12–16 rotations per year split between hospital wards, intensive care units, emergency departments, out-patient clinics, etc. At the second level are the daily transitions trainees experience while on a rotation (e.g. 'clinical service'), such as sign-outs and hand-offs, patient admissions, patient discharges, and movement between different clinical units within a hospital. Many of these transitions occur multiple times within a single day. These transitions are not the subject of this paper, but it is worth noting that they contribute mightily to the complexity of managing transitions in general.

Other actors in the transitional process

Doctor faculty (hereon simply referred to as 'faculty') represent other primary participants in this rotational dance. Faculty staff in many training programmes are embedded into the same rotational structure as trainees and must engage in the same transitions. These clinical rotations, particularly within the context of the demand for trainee supervision, the reduction in student and postgraduate trainee availability as a result of duty hour restrictions, and

increased patient complexity, significantly detract from the time faculty members have available to attend to teaching, mentoring, research and clinical productivity.[16–18] Moreover, like trainees, many faculty staff are transient members of the clinical units in which they supervise trainees and oversee patient care.

Nurses and ancillary staff also experience transitions and are often used as sources of support and guidance during transitions, particularly by students and residents. The main difference is that nurses and ancillary staff are the stable members of the clinical unit. They serve as vital threads of continuity, not only for trainees and faculty members, but, perhaps more importantly, also for patients and their families, but little is known about how the disruption caused by moving trainees and faculty in and out of the clinical unit affects these vital health care workers. Similarly, little has been written about the effects of rotational transitions on the patient population, although we know that daily transitions during rotations are fraught with risk for patients.[19–22]

Current assumptions about rotational transitions

Although trainees obviously need to experience some transitions throughout the educational process, the questions we need to ask ourselves concern how many rotational transitions make sense, how they should be structured, and how residents (and other 'actors') should prepare for them. As we embrace competency-based models of training, the unit of progression for the trainee will increasingly evolve to one comprising the mastery of specific knowledge, skills and attitudes utilising a learner-centred curriculum.[7,22,23] If we are truly committed to optimising educational outcomes, we must acknowledge that the time has come to test our assumptions about the value and educational role of rotational transitions, and about whether and how they facilitate or impede the trainee's ability and

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- One to six blocks, or equivalent longitudinal rotation, in community/rural paediatrics
- One to four blocks, or equivalent longitudinal rotation, in ambulatory/hospital-based out-patient paediatrics
- Two to four blocks, or equivalent longitudinal rotation, in in-patient ward/CTU paediatrics as a junior resident
- Two to four blocks, or equivalent longitudinal rotation, in in-patient ward/CTU paediatrics as a senior resident
- One or two blocks, or equivalent longitudinal rotation, in developmental paediatrics
- Three to five blocks, or equivalent longitudinal rotation, in neonatal intensive care unit. This training must include one block in normal newborn/level II exposure, and two or more blocks in level III
- Two to three blocks in paediatric intensive care unit
- One to four blocks in paediatric emergency medicine

Figure 1 Core rotational requirements for Canadian residencies in paediatrics. CTU = clinical trials unit

opportunity to become, at minimum, a competent doctor. Some of these assumptions are:

1 frequent rotations allow for greater diversity and breadth of exposure to different disciplines and more opportunities to learn in medical school, and, in postgraduate training, more concentrated focus on subspecialty areas as a method to develop expertise;

2 frequent rotations effectively teach residents how to adapt to and cope with multiple practice styles, varying expectations and stress, all of which are skills that will be necessary in their future practice, and

3 frequent rotations promote greater trainee independence in action by forcing them to adapt and learn on their own.

These assumptions have been codified and reinforced by accreditation and certification policies in several countries, most notably the USA and Canada,[8,9,24,25] the development of which was spurred by the Flexner report.[26] However, one of the primary drivers of the 'fragmentation' of training, which feeds into the first assumption, was the rise of specialisation in the 1950s, which has continued, if not accelerated, to this day.[3,26] Assumptions 2 and 3 are deeply embedded in the autonomous culture of American, British and Canadian training.[27–29] A recent study from the USA found that many faculty members believe that the flexibility and adaptability required during rotational transitions is good for trainees.[30]

These assumptions are now deeply embedded into our current medical education models; however, it is not clear how pleased Flexner would be with how things stand 100 years after his recommendations.[2,3] Flexner believed in the importance of 'close and sustained contact with faculty' in the context of meaningful longitudinal immersion in the clinical environment. Although our current assumptions may indeed contain truths, we will highlight some of the limitations and potentially counterproductive effects of transitions, using both theoretical insights and empirical data from three perspectives to guide and support our interpretations and suggest avenues for future research.

THE SOCIOLOGICAL PERSPECTIVE

There is a substantial literature on the socialisation process inherent in medical training and medicine as a profession.[31–37] Sociologists conceive of medical training as a process by which new values and behaviours are inculcated, appropriate to 'membership' in the field of medicine. These changes are internalised in the course of induction or training procedures, whether formally or informally,[38,39] and often result in new images, expectations, skills and norms as trainees define themselves and as others view them. With this in mind, we need to think carefully about the socialisation process involved in the rotational model. Switching medical students and residents between clinical services every 2–4 weeks may impede or delay adequate socialisation, resulting in specific behaviours and patterns that may be counterproductive to both professional development and patient care. In their study of 10 US schools, O'Brien and colleagues found that students struggled to adjust to new clinical cultures, engage in multiple
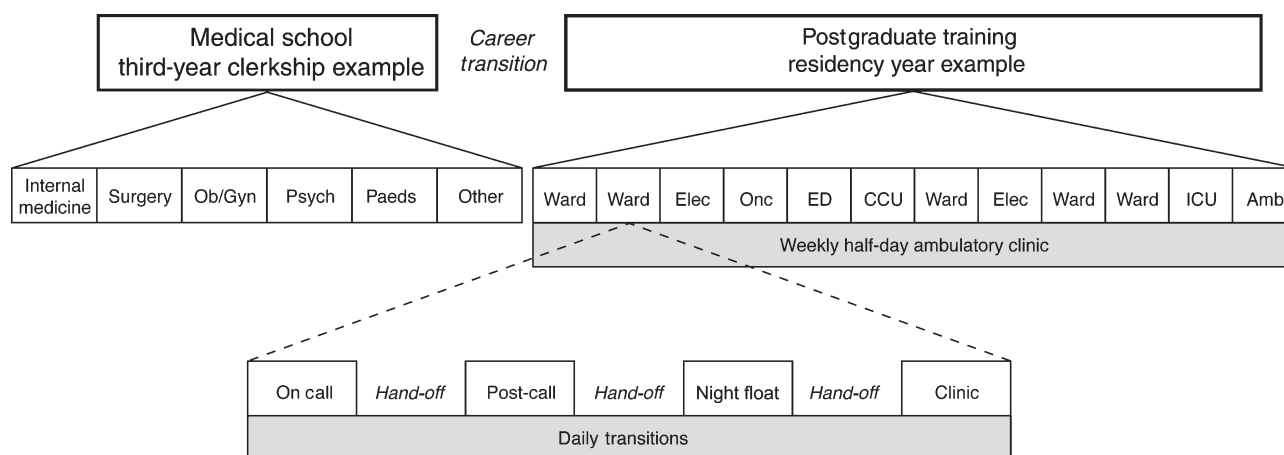

Figure 2 Nature and frequency of educational transitions. Ob/Gyn = obstetrics and gynaecology; Psych = psychiatry; Paeds = paediatrics; Elec = elective; Onc = oncology; ED = emergency department; CCU = critical care unit; ICU = intensive care unit; Amb = ambulatory

changes in staff and settings, and understand their roles and responsibilities.[40]

To begin, there is evidence suggesting that the 'hidden curriculum' and the mixed messages learners frequently experience during clinical rotations may erode the humanistic traits essential to the delivery of high-quality care.[41] Further, we draw attention to the concepts of 'ethical' and 'moral' relativism,[42,43] which posit that ethical choices are made on the basis of what looks reasonable according to one's own belief or value system, and that moral judgement is not absolute, but, rather, relative to particular groups of individuals. A full explanation of the organisational, cognitive and social information-processing factors involved in ethical decision making is beyond the scope of this paper, but we encourage our audience to think about the implications of expecting trainees to continuously adapt to new environments and faculty standards from a professional development perspective. Specifically, we highlight the potential for trainees to fail to learn absolute or ideal ethical standards, which may lead to moral neutrality and inaction in situations that may be intolerable.

There is limited evidence, for example, that trainees may acquire dysfunctional strategies to cope with and adapt to constant transitions between and within systems, including personal workarounds, prioritising efficiency over patient-centredness, 'turfing' behaviours (e.g. deliberately transferring patients to another clinical service or blocking the hospital admission of a patient to one's own clinical team), conflict, misrepresenting clinical information about patients, withholding information from attending doctors, and outright lying.[28,29,38,39,44,45] It appears that these behaviours are more likely to be used on 'switch days', when the trainee is required to pick up a new service of many ill patients on a hospital ward, often with little support from faculty staff.[30]

Further, frequent transitions may marginalise trainees' relationships with patients. Christakis and Feudtner highlighted the pervasive problem of transient social relationships, suggesting that the transient encounter 'hampers trainees' capacity to build long-term relationships with patients'.[44] Patients value relationships, and a growing body of work is beginning to provide evidence for the benefits of relationship-centred care.[46] However, developing patient relationships takes significant time and effort. Switching trainees between clinical services every 2–4 weeks perpetually reinforces this transience in relationships with patients and forces trainees to make difficult choices about which patients to engage with and how deeply in the context of increasingly intense pressure to get patients in and out of hospital efficiently.

Although meaningful relationships with patients are unquestionably important, so are relationships with others on the health care team.[47–49] Too often the definition of 'team' for a trainee is the trainee him- or herself, the other medical trainees on the rotation (students, interns, etc.) and the faculty attending doctor, a definition that fails to acknowledge other individuals caring for the patient. Baker and colleagues[47] delineated a set of key teamwork competencies trainees must acquire, including mutual performance monitoring, effective back-up behaviour, team or collective orientation, shared mental models and mutual trust. From this list, it is clear that effective interdisciplinary teamwork is grounded in meaningful relationships among team members. Our current rotational structure makes such relationships and the opportunity to acquire critical teamwork competencies very difficult.

Our present rotational structure may also reinforce traditional, outmoded views of doctor autonomy.[38,39,44] According to MacDonald,[50] there are two key aspects of the traditional view of autonomy: the capacity for self-governance, and non-interference with the professional's control over his or her life and actions. However, this view fails to account for social context and, in the case of doctors, failure to recognise whether the institutional culture, or specific situation, is, or is not, supportive of independent judgement.

In essence, professional autonomy should be granted and re-conceptualised as 'relational autonomy'.[51] Relational autonomy recognises that human agents are *interconnected* and *interdependent*, meaning autonomy is socially constructed and that action is:

'…dependent upon particular social relationships and the power structures in which we are embedded. Autonomy requires more than mere freedom from interference; it requires that one's relationships with particular individuals and institutions be constituted in such a way as to give one genuine opportunities for choice.'[51]

However, frequent transitions and the resulting transient nature of relationships with other members of the health care team lead, in the words of Christakis and Feudtner,[44] to a 'conflating of trust and authority' by the trainee and faculty. Authority

requires trust and trust needs to be earned; too often they are seen by the trainee and faculty as one and the same. One of the primary issues now facing medical education is the need to reduce our tendency to train health care professionals in isolation from one another, and to consider ways of integrating training programmes so that health care professionals can come to a better understanding of their interdependence.[52] Furthermore, the relationships medical students and postgraduate trainees do or do not develop also affect their identity formation and probably shape future behaviours.[53] In summary, we need to pay much greater attention to how frequent transitions affect interprofessional relationships and professional development.

THE LEARNING THEORY PERSPECTIVE

There is a mismatch between the broad range of learning theories offered in the wider education literature and the relatively narrow range of theories privileged in the medical education literature.[54] For example, in Regehr's[55] critical overview of trends in medical education research, references to theories of learning that stress the importance of dynamic socio-cultural context are notably absent. Moreover, most applied learning theories in medical education focus on an isolated individual and fail to explain fully how learning occurs in dynamic, complex and unstable clinical teams or systems.[54,56–59] This is particularly intriguing given health care's recent emphasis on the benefits of teamwork and systems-based patient safety. In addition to the advantages of improving patient care through better interprofessional teamwork,[47] non-doctor members of health care teams can also be wonderful sources of teaching and learning.[60] Although no single learning theory has enough explanatory and predictive power to inform the range of practices found in medicine, individualistic models of learning must be supplemented with socio-cultural learning theories so that educators can better understand how new knowledge is produced and held collaboratively in inherently unstable, complex teams and systems.[54]

Integrating socio-cultural and competency-based components of learning would clearly hold significant implications for assessment and feedback. Defining what we expect trainees to 'look like' at various stages of training allows for more targeted curricular approaches and less dependence on dwell time as a proxy for competence. However, although substantial progress has been made in the development of competency frameworks and assessment of

medical professionals, competency-based medical education places a greater burden on assessment compared with other educational models, especially formative assessment and high-quality, timely feedback.[15] Faculty should be working alongside trainees on a daily basis to provide real-time evaluation and feedback. Ericsson's[61,62] seminal work highlights the importance of coaching, role-modelling and mentoring as part of the development of expertise.

Furthermore, trainees should spend concentrated time learning and applying knowledge and skills under watchful and critical eyes. Yet, it is hard to imagine how moving trainees and faculty (the presumed coaches) around every 2–4 weeks facilitates high-quality assessment and feedback. In the USA, for example, clinical service demands on faculty have led many institutions to adopt 2-week faculty attending doctor blocks, with the result that medical students, interns and residents may encounter three or more different faculty attending doctors in just one 4-week rotation. This situation makes it very difficult for the trainee to develop a meaningful relationship with the faculty teacher, and leads to, at best, superficial assessment and feedback. In addition, this set-up makes it very difficult for the trainee to build on prior assessment and feedback as part of his or her professional development.

Compounding this situation is the reluctance to feed forward information about trainees from one faculty member to the incoming member because of fears, bias or prejudice around grades.[63–65] The net result is that the new faculty member must start from scratch (if at all) to determine where the trainee is developmentally. The cumulative effect of multiple faculty and trainee rotational transitions may lead to educational inertia and arrested professional development. At worst, trainees with serious deficiencies are simply passed along without intervention to correct the problems.[66,67]

Lastly, we know that trainees' abilities to self-assess and self-supervise are inadequate and inaccurate (as they are in all professionals), especially among the least knowledgeable and skilled.[68–70] Trainees are also at risk for feelings of impostorism,[71] characterised by an inability to internalise a sense of competence or skill despite concrete evidence of their abilities.[72] A recent study by Legassie *et al.*[73] demonstrated a prevalence of impostorism in residents similar to that found in other health professions trainees, with a lack of association between programme year and feelings of impostorism. This is somewhat disconcerting as educators would hope to

see feelings of inadequacy or self-doubt decrease with training and experience.[53] However, as trainees are repeatedly forced to adapt to new clinical rotations, expectations, responsibilities and pressures, it is possible that a subset fail to realise or reach their potential as they simply do what they need to in order to 'survive' and endure each transition.

In fairness, some educators might argue that frequent transitions improve equitability in evaluation by increasing the sample of faculty and others who evaluate and judge the trainee. This is certainly consistent with psychometric principles: reliability is usually better with higher numbers of evaluators.[74] In addition, although this is not necessarily a legitimate reason in the eyes of many,[26] hospitals and training institutions do have patient care service needs and a rotational structure can be the most optimal approach to balancing educational and clinical service needs. However, we can legitimately hypothesise that a merry-go-round of faculty and trainee transitions, especially when key developmental information is not internalised or fed forward, is unlikely to optimise educational outcomes.

Although the majority of current training models around the world use the rotational model to varying degrees, some have already challenged it through the redesign of the traditional clerkship model in medical school. Over the past 10 years, a number of schools have implemented or experimented with the longitudinal integrated clinical clerkship (LICC) model.[75–79] Norris and colleagues[77] recently reported on the experience of 16 schools from Australia, Canada, South Africa and the USA. Overall, students were satisfied with their experience and no difference was found on national examinations compared with students in the traditional clerkship model, but two schools reported that students in the LICC programme were more likely to 'maintain high levels of humanism and patient-centredness'.[77] However, a separate study noted the significantly increased impact on preceptor time and resources of the LICC model.[80] In summary, we need to urgently address the gap between what is known from the pedagogical and cognitive sciences, and what is currently practised, in order to thoughtfully redesign and plan educational transitions.

THE QUALITY AND PATIENT SAFETY PERSPECTIVE

Doctor competence in quality improvement and patient safety science is now considered core to successful doctor practice.[81,82] By the end of training, doctors entering practice must possess a set of knowledge, skills and attitudes that will allow them to engage in improving quality and patient safety immediately in their new practice setting.[81–84] From this perspective, it is helpful to examine the predominant clinical units in which trainees work and learn, such as the ambulatory clinic, hospital ward, surgical suite or intensive care unit, as microsystems.[85–87]

Unfortunately, substantial evidence exists that trainees too often must learn and work in dysfunctional microsystems.[32,88] This situation is further compounded when we force trainees to move between dysfunctional microsystems as part of the current rotational structure of training. Microsystems are by nature complex adaptive systems that consist of multiple interconnected elements including individuals who have the capacity to learn from one another, adapt and therefore change.[87,89] Functional microsystems depend on the existence of effective and meaningful interactions and relationships between individuals. As Batalden and colleagues pointed out, successful microsystems are characterised in part by strong interdependence between members, continuous quality improvement and the generation of performance results.[87] It is hard to imagine how trainees who spend only 4 weeks in a microsystem can have sufficient time and interaction to assimilate the necessary knowledge, skills and attitudes about systems-based practice and how best to function in a microsystem.

These challenges are even more acute in ambulatory training, in which trainees in a number of specialties may rotate in and out of a clinic to see patients for perhaps half a day per week, or may rotate between multiple clinics during an ambulatory block or posting. Several recent studies of ambulatory training highlight the significant challenges involved in immersing trainees in an effective microsystem while ensuring the provision of high-quality care. Lynn and colleagues compared the quality of care provided to older adults by internal medicine and family medicine trainees in 52 training clinics with that provided by practising doctors participating in a maintenance of certification programme in the USA. Older patients in the residency clinics were significantly less likely to receive recommended geriatric-specific and other services compared with patients cared for by practising doctors.[90] The residency clinic microsystems were also less likely to incorporate elements designed to support necessary services for patients. Another study found ambulatory clinics had highly

variable availability of key electronic health information systems.[91] One cannot easily develop the necessary skills in quality improvement and patient safety by working in dysfunctional microsystems and providing substandard care.

Learning to bring about changes in quality and safety also requires time and ongoing interactions. For example, the Plan-Do-Study-Act (PDSA) rapid cycle approach to quality improvement requires a series of iterative steps, often carried out by an interdisciplinary team, to achieve a meaningful outcome.[85,92] However, as noted in several recent reviews, trainees are seldom active participants on quality improvement teams or projects, and the rotational nature of training is a major contributor to this current state of affairs.[93,94] At best, trainees are often moved in and out of quality improvement activities in order to accommodate their fragmented training schedules.[77] Yet, when residents do work interactively with interprofessional teams, they not only learn competency in quality improvement skills, but also learn how to work with non-doctor staff to bring about improvements.[95,96] Trainees are also a valuable source of information about what doesn't work and can provide valuable insight into how to improve work processes and safety.[97,98]

If trainees are to effectively acquire and apply the core knowledge, skills and attitudes of the quality improvement, practice-based learning and improvement, and systems-based practice competencies, educators will need to re-think current educational structures. Interprofessional relationships and teamwork are central to providing high-quality care. Clinical experiences should be designed to facilitate learning in a manner that allows the trainee to function as part of an effective interprofessional team that works together longitudinally to resolve meaningful problems. This, in turn, allows the trainee to take on challenging problems that promote the acquisition of adaptive forms of expertise.[26,61,62] Otherwise, we will continue to reinforce the 'trainee as tourist' mentality in the critical learning activities of quality improvement, patient safety and systems change.

CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

As an educational community, we have been very complacent about the basic architecture of medical education, despite a growing body of evidence from multiple fields and critical perspectives that strongly suggests that the current rotational model needs close examination. Although some progress has been made, such as by the introduction of integrated clerkships during medical school,[75–79] few changes have been implemented in the nature and structure of training for decades. In their just-released report, *Educating Physicians: A Call for Reform of Medical School and Residency*, Cooke *et al.* argue strongly that medical education across the continuum must move to 'standardise learning outcomes through assessment of competencies' while 'individualising the learning process within and across levels' of training that should 'incorporate interprofessional education and teamwork'.[26] If this is truly the ultimate goal for the future of medical education, we must challenge our assumptions about the benefits and impact of the current rotational architecture of training. It is hard to imagine that a training programme based on 2–8-week block rotations can effectively enable the transformation to a competency-based model. Another important principle that should guide the transformation of medical education is that of 'educational continuity'. As Hirsch and colleagues argue, continuity overseen by a governance structure that is interprofessional and collaborative can provide the necessary framework to accommodate different models of training.[79]

The transformation of medical education demands that we test our assumptions as assumptions lest they become our intractable truths in the face of disconfirming evidence that change is needed.[99] The lack of ongoing supervision and longitudinal relationships with faculty profoundly conflict with growing evidence from the literature on the development of expertise. We believe it is time to examine the effects of these rotational transitions using the three-perspective framework. To that end, the American Board of Internal Medicine has begun work to better understand, as a first step, how these frequent transitions are viewed and experienced by trainees, faculty and non-doctor staff. The ultimate goal of the research should be to provide critical data to guide the redesign of educational structures and processes that enable and facilitate outcomes-based training and ensure patients receive high-quality care. We welcome any partner who may wish to join us on the journey.

REFERENCES

1   Flexner A. *Medical Education in the United States and Canada: A Report to the Carnegie Foundation for the Advancement of Teaching [Carnegie Foundation Bulletin No. 4].* New York, NY: Carnegie Foundation for the Advancement of Teaching 1910.

2   Cooke M, Irby DM, Sullivan W, Ludmerer KM. American medical education 100 years after the Flexner report. *N Engl J Med* 2006;**355**:1339–44.

3   Ludmerer K. *Time to Heal: American Medical Education from the Turn of the Century to the Era of Managed Care.* New York, NY: Oxford University Press 1999; 3–26.

4   Whitcomb ME. Commentary: Flexner redux 2010: graduate medical education in the United States. *Acad Med* 2009;**84**:1476–8.

5   Liaison Committee for Medical Education. Accreditation standards. http://www.lcme.org/standard.htm . [Accessed 27 January 2010.]

6   Jones MD Jr, McGuinness GA, First LR, Leslie LK, Residency Review and Redesign in Pediatrics Committee. Linking process to outcome: are we training pediatricians to meet evolving health care needs? *Pediatrics* 2009;**23**(Suppl 1):1–7.

7   Holmboe ES, Bowen JD, Green M, Gregg J, DiFrancesco L, Reynolds E, Alguire P, Battinelli B, Lucey C, Duffy FD. Reforming internal medicine residency training: a report from the Society of General Internal Medicine's Task Force for Residency Reform. *J Gen Intern Med* 2005;**20** (12):1165–72.

8   Royal College of Physicians and Surgeons of Canada. Specialty training requirements. http://rcpsc.medical.org/information/ . [Accessed 11 June 2010.]

9   Royal College of Physicians and Surgeons of Canada. Specialty training requirements in pediatrics. http://rcpsc.medical.org/residency/certification/training/pediat_e.pdf . [Accessed 11 June 2010.]

10 Carraccio C, Wolfsthal SD, Englander R, Ferentz K, Martin C. Shifting paradigms: from Flexner to competencies. *Acad Med* 2002;**77**:361–7.

11 Harden RM. Outcomes-based education: the future is today. *Med Teach* 2007;**29**:625–9.

12 Harden RM. International medical education and future directions: a global perspective. *Acad Med* 2006;**12** (Suppl):22–9.

13 Nasca TJ. Where will the 'milestones' take us? The next accreditation system. ACGME [Accreditation Council for Graduate Medical Education] Bulletin September 2008. http://www.acgme.org/acWebsite/bulletin/ACG11_BulletinSep08_F.PDF . [Accessed 21 September 2010.]

14 Teunissen PW, Westerman M. Opportunity or threat: the ambiguity of transitions in medical education. 2010.

15 Lipner RS, Bylsma WH, Arnold GK, Fortna GS, Tooker J, Cassel CK. Who is maintaining certification in internal medicine – and why? A national survey 10 years after initial certification *Ann Intern Med* 2006;**144**:29–36.

16 Association of American Medical Colleges. *Educating Doctors to Provide High Quality Medical Care: A Vision for Medical Education in the United States.* Washington, DC: AAMC 2004.

17 Institute of Medicine. *Resident Duty Hours: Enhancing Sleep, Supervision, and Safety.* Washington, DC: National Academy Press 2008.

18 Goddard A, Pounder R, McIntyre A, Newberry T. Implementation of the European Working Time Directive in 2009 – implications for UK clinical service provision and training for the medical specialties. Royal College of Physicians. http://www.rcplondon.ac.uk/professional-issues/workforce/workforce-issues/pages/ewtd.aspx . [Accessed 25 January 2010.]

19 Horwitz LI, Moin T, Krumholz HM, Wang L, Bradley EH. What are covering doctors told about their patients? Analysis of sign-out among internal medicine house staff *Qual Saf Health Care* 2009;**18**:248–55.

20 Horwitz LI, Moin T, Krumholz HM, Wang L, Bradley EH. Consequences of inadequate sign-out for patient care. *Arch Intern Med* 2008;**168**:1755–60.

21 Arora V, Johnson J, Lovinger D, Humphrey HJ, Meltzer DO. Communication failures in patient sign-out and suggestions for improvement: a critical incident analysis. *Qual Saf Health Care* 2005;**14**:401–7.

22 Arora VM. Tackling care transitions: mom and apple pie vs. the devil in the details. *J Gen Intern Med* 2009;**24**:985–7.

23 Smith SR, Dollase R. AMEE Guide No. 14: outcomes-based education. Part 2: planning, implementing and evaluating a competency-based curriculum. *Med Teach* 1999;**21**:15–22.

24 Accreditation Council for Graduate Medical Education. Program directors and coordinators. http://www.acgme.org/acWebsite/navPages/nav_PDcoord.asp . [Accessed 11 June 2010.]

25 American Board of Medical Specialties. What board certification means. http://www.abms.org/About_Board_Certification/ . [Accessed 11 June 2010.]

26 Cooke M, Irby DM, O'Brien BC. *Educating Physicians: A Call for Reform of Medical School and Residency. [Carnegie Foundation for the Advancement of Teaching.]* San Francisco, CA: Jossey-Bass 2010.

27 Reinertsen JL. Zen and the art of physician autonomy maintenance. *Ann Intern Med* 2003;**138**:992–5.

28 Kennedy TJT, Regehr G, Baker GR, Lingard LA. 'It's a cultural expectation…' The pressure on medical trainees to work independently in medical practice. *Med Educ* 2009;**43**:645–53.

29 Kennedy TJT, Regehr G, Baker GR, Lingard LA. Preserving professional credibility: grounded theory study

of medical trainees' requests for clinical support. *BMJ* 2009;**338**:128–35.

30 Bernabeo EC, Holtman MH, Ginsburg S, Rosenbaum JR, Holmboe ES. Lost in transition: the experience and impact of rapid changes in the inpatient learning environment. 2010 [Under review]

31 Newble D, Stark P, Bax N, Lawson M. Developing an outcome-focused core curriculum. *Med Educ* 2005;**39**:680–7.

32 Keirns CC, Bosk CL. Perspective: the unintended consequences of training residents in dysfunctional outpatient settings. *Acad Med* 2008;**83**:498–502.

33 Starr PE. *The Social Transformation of American Medicine: The Rise of a Sovereign Profession and the Making of a Vast Industry.* New York, NY: Basic Books 1982; 230–90.

34 Freidson E. *Profession of Medicine. A Study of the Sociology of Applied Knowledge.* Chicago, IL: University of Chicago Press 1988;3–71.

35 Hafferty FW, Light DW. Professional dynamics and the changing nature of medical work. *J Health Soc Behav* 1995;**35**:132–53.

36 Becker H, Geer B, Hughes C, Strauss A. *Boys in White.* Chicago, IL: University of Chicago Press 1961; 3–25.

37 Bosk C. *Forgive and Remember: Managing Medical Failure.* Chicago, IL: University of Chicago Press 2003;**138**:35–71.

38 Hafferty FW, Franks R. The hidden curriculum, ethics teaching and the structure of medical education. *Acad Med* 1994;**69**:861–71.

39 Hafferty FW. Beyond curriculum reform: confronting medicine's hidden curriculum. *Acad Med* 1998;**73**: 403–7.

40 O'Brien B, Cooke M, Irby DM. Perceptions and attributions of third-year student struggles in clerkships: do students and clerkship directors agree? *Acad Med* 2007;**82**:970–8.

41 Crandall SJ, Marion GS. Commentary: identifying attitudes towards empathy: an essential feature of professionalism. *Acad Med* 2009;**84** (9):1174–6.

42 Harman G. Moral Relativism. In: Harman G, Thompson JJ, eds. *Moral Relativism and Moral Objectivity.* Cambridge, MA: Blackwell Publishers 1996;3–64.

43 Wong DB. *Moral Relativity.* Berkeley, CA: University of California Press 1984;**43**:5–31.

44 Christakis DA, Feudtner C. Temporary matters: the ethical consequences of transient social relationships in medical training. *JAMA* 1997;**278**:739–43.

45 Rosenbaum JR, Bradley EH, Holmboe ES, Farrell M, Krumholz HM. Sources of ethical discomfort in medical housestaff training. *Am J Med* 2004;**116**:402–7.

46 Suchman AL. A new theoretical foundation for relationship-centred care. Complex responsive processes of relating. *J Gen Intern Med* 2006;**21** (Suppl 1):40–4.

47 Baker DP, Salas E, King H, Battles J, Barach P. The role of teamwork in professional education of physicians: current status and recommendations. *Jt Comm J Qual Saf* 2005;**31**:185–202.

48 Leggat SG. Effective teamwork requires effective team members: defining teamwork competencies. *BMC Health Serv Res* 2007;**7**:17.

49 Zwarenstein M, Reeves S. Knowledge translation and interprofessional collaboration: where the rubber of evidence-based care hits the road of teamwork. *J Contin Educ Health Prof* 2006;**26**:46–54.

50 MacDonald C. Nurse autonomy as relational. *Nurs Ethics* 2002;**9**:194–201.

51 Sherwin S. A relational approach to autonomy in health care. In: Sherwin S, ed. *The Politics of Women's Health: Exploring Agency and Autonomy.* Philadelphia, PA: Temple University Press 1998;19–47.

52 Lanham HJ, McDaniel RR Jr, Crabtree BF, Miller WL, Stange KC, Tallia AF, Nutting P. How improving practice relationships among clinicians and non-clinicians can improve quality in primary care. *Jt Comm J Qual Patient Saf* 2009;**35** (9):457–66.

53 Monrouxe LV. Identity, identification and medical education: why should we care? *Med Educ* 2010;**44**:40–9.

54 Bleakley A. Broadening conceptions of learning in medical education: the message from teamworking. *Med Educ* 2006;**40**:150–7.

55 Regehr G. Trends in medical education research. *Acad Med* 2004;**79**:939–47.

56 Knowles M. *The Adult Learner: A Neglected Species.* Houston, TX: Gulf Publishing 1978;**39**:6–35.

57 Brookfield S. *Understanding and Facilitating Adult Learning.* Milton Keynes: Open University Press 1986;**83**:25–40.

58 Boud D. *Developing Student Autonomy in Learning.* London: RoutledgeFalmer 1987;5–40.

59 Kolb D. *Experiential Learning.* Englewood Cliffs, NJ: Prentice Hall 1984;1–38.

60 Hall P, Weaver L. Interdisciplinary education and teamwork: a long and winding road. *Med Educ* 2006;**35** (Suppl):16–20.

61 Ericsson KA. The influence of expertise and deliberate practice on the development of superior expert performance. In: Ericsson KA, Charness N, Hoffman RR, Feltovich PJ, eds. *Cambridge Handbook of Expertise and Expert Performance.* Cambridge: Cambridge University Press 2006;683–704.

62 Ericsson KA. An expert-performance perspective of research on medical expertise: the study of clinical performance. *Med Educ* 2007;**41** (12):1124–30.

63 Cleary L. 'Forward feeding' about students' progress: the case for longitudinal, progressive and shared assessment of medical students. *Acad Med* 2008;**83** (9):800.

64 Cox SM. 'Forward feeding' about students' progress information on struggling medical students should not be shared among clerkship directors or with students' current teachers. *Acad Med* 2008;**83** (9):801.

65 Pangaro L. 'Forward feeding' about students' progress: more information will enable better policy. *Acad Med* 2008;**83** (9):802–3.

66 Lucey CR, Boote RM. Working with problem residents: a systematic approach. In: Holmboe ES,

Hawkins RE, eds. *Practical Guide to the Evaluation of Clinical Competence*. Philadelphia, PA: Mosby-Elsevier 2008;201–15.

67 Hauer KE, Ciccone A, Henzel TR, Katsufrakis P, Miller SH, Norcross WA, Papadakis MA, Irby DM. Remediation of the deficiencies of physicians across the continuum from medical school to practice: a thematic review of the literature. *Acad Med* 2009;**84**:1822–32.

68 Davis DA, Mazmanian PE, Fordis M, Van Harrison R, Thorpe KE, Perrier L. Accuracy of physician self-assessment compared with observed measures of competence: a systematic review. *JAMA* 2006;**296**: 1094–102.

69 Eva KW, Cunnington JP, Reiter HI, Keane DR, Norman GR. How can I know what I don't know? Poor self-assessment in a well-defined domain *Adv Health Sci Educ Theory Pract* 2004;**9**:211–24.

70 Eva KW, Regehr G. 'I'll never play professional football' and other fallacies of self-assessment. *J Contin Educ Health Prof* 2008;**28**:14–9.

71 Clance PR, Imes SA. The impostor phenomenon in high-achieving women: dynamics and therapeutic intervention. *Psychother Theory Res Pract* 1978;**15**:241–7.

72 Langford J, Clance PR. The impostor phenomenon: recent research findings regarding dynamics, personality and family patterns and their implications for treatment. *Psychotherapy* 1993;**30**:495–501.

73 Legassie J, Zibrowski EM, Goldszmidt MA. Measuring resident well-being: impostorism and burnout syndrome in residency. *J Gen Intern Med* 2008;**23** (7):1090–4.

74 Axelson RD, Kreiter CD. Reliability. In: Downing SM, Yudkowsky R, eds. *Assessment in the Health Professions*. New York, NY: Routledge 2009;57–75.

75 Mihalynuk T, Bates J, Page G, Fraser J. Student learning experiences in a longitudinal clerkship programme. *Med Educ.* 2008;**42**(7):729–32.

76 Ogur B, Hirsh D. Learning through longitudinal patient care-narratives from the Harvard Medical School-Cambridge integrated clerkship. *Acad Med* 2009;**84**:844–50.

77 Norris TE, Schaad DC, DeWitt D, Ogur B, Hunt DD, Consortium of Longitudinal Integrated Clerkships. Longitudinal integrated clerkships for medical students: an innovation adopted by medical schools in Australia, Canada, South Africa, and the United States. *Acad Med* 2009;**84**:902–7.

78 Hauer KE, O'Brien B, Poncelet AN. Longitudinal, integrated clerkship education: better for learners and patients. *Acad Med* 2009;**84**:821.

79 Hirsh DA, Ogur B, Thibault GE, Cox M. Continuity as an organising principle for clinical educational reform. *N Engl J Med* 2007;**356**:858–66.

80 Teherani A, O'Brien BC, Masters DE, Poncelet AN, Robertson PA, Hauer KE. Burden, responsibility, and reward: preceptor experiences with the continuity of teaching in a longitudinal integrated clerkship. *Acad Med* 2009;**84 (Suppl)**:50–3.

81 Ogrinc G, Headrick LA, Morrison LJ, Foster T. Teaching and assessing resident competence in practice-based learning and improvement. *J Gen Intern Med* 2004;**19**:496–500.

82 Ogrinc G, Headrick LA, Mutha S, Coleman MT, O'Donnell JO, Miles PV. A framework for teaching medical students and residents about practice-based learning and improvement, synthesised from a literature review. *Acad Med* 2003;**78**:748–56.

83 Institute of Medicine. *Educating Health Professionals: A Bridge to Quality*. Washington, DC: National Academy Press 2003.

84 Audet AM, Doty MM, Shamasdin J, Schoenbaum SC. Measure, learn, and improve: physicians' involvement in quality improvement. *Health Aff* 2005;**24**:843–53.

85 Nelson EC, Batalden PB, Godfrey MM, eds. *Quality by Design: A Clinical Microsystems Approach*. San Francisco, CA: Jossey-Bass 2007;3–51.

86 Nelson EC, Batalden PB, Huber TP, Mohr JJ, Godfrey MM, Headrick LA, Wasson JH. Microsystems in healthcare. Part 1: learning from high-performing front-line clinical units. *Jt Comm J Qual Saf* 2002;**28**: 472–93.

87 Batalden PB, Nelson EC, Edwards WH, Godfrey MM, Mohr JJ. Microsystems in healthcare. Part 9: developing small clinical units to attain peak performance. *Jt Comm J Qual Saf* 2003;**29**:575–85.

88 Bowen JL, Salerno SM, Chamberlain JK, Eckstrom E, Chen HL, Brandenburg S. Changing habits of practice. Transforming internal medicine residency education in ambulatory settings. *J Gen Intern Med* 2005;**20**:1181–7.

89 McDaniel RR, Driebe DJ. Complexity science and health care management. In: Blair JD, Fottler MD, Savage GT, eds. *Advances in Health Care Management*, Vol. 2. Stamford, CT: JAI Press 2001;11–36.

90 Lynn LA, Hess BJ, Conforti LN, Lipner RS, Holmboe ES. The effect of residency clinic systems on the quality of care for older adults in internal and family medicine residency programmes. *Acad Med* 2009;**84**:1732–40.

91 Reddy SG, Babbott SF, Beasley BW, Nadkarni M, Gertner E, Holmboe ES. Prevalence and functionality of electronic health records in internal medicine continuity clinics. *Acad Med*; 2010;**85**(5):787–90.

92 Langley GJ, Nolan KM, Nolan TW, Norman CL, Provost LP. *The Improvement Guide. A Practical Approach to Enhancing Organizational Performance*. San Francisco, CA: Jossey-Bass 1996;3–29.

93 Philibert I. Involving residents in quality improvement: contrasting 'top-down' and 'bottom-up' approaches. Accreditation Council for Graduate Medical Education and Institute for Healthcare Improvement 90-Day Project. http://www.acgme.org/acWebsite/ci/90Day-ProjectReportDFA_PA_09_15_08.pdf . [Accessed 15 January 2010.]

94 Windish DM, Reed DA, Boonyasai RT, Chakraborti C, Bass EB. Methodological rigor of quality improvement curricula for physician trainees: a systematic review and recommendations for change. *Acad Med* 2009;**84**:1677–92.

95 Warm EJ. Interval examination: the ambulatory long block. *J Gen Intern Med* 2010;**25**:750–2.

96 Warm EJ, Schauer DP, Diers T, Mathis BR, Neirouz Y, Boex JR, Rouan GW. The ambulatory long-block: an Accreditation Council for Graduate Medical Education (ACGME) educational innovations project (EIP). *J Gen Intern Med* 2008;**23** (7):921–6.

97 Volpp GM, Grande D. Residents' suggestions for reducing errors in teaching hospitals. *N Engl J Med* 2003;**348**:851–5.

98 Holmboe ES, Prince L, Green ML. Teaching and improving quality of care in a residency clinic. *Acad Med* 2005;**80**:571–7.

99 Kegan R, Lahey LL. *How the Way We Talk Can Change the Way We Work*. San Francisco, CA: Jossey-Bass 2001;67–88.