

How do doctors use information in real-time? A qualitative study of internal medicine resident precepting

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Abstract

Background Despite the importance of evidence-based medicine in medical education, little observational research exists on how doctors-in-training seek and use evidence from information resources in ambulatory care.

Objective To describe information exchange behaviour by internal medicine residents and attendings in ambulatory resident clinic precepting rooms.

Design We observed resident behaviour and audiotaped resident–attending doctor interactions during precepting sessions.

Participants Participating residents included 70 of an eligible 89 residents and 28 of 34 eligible attendings from one large academic internal medicine residency programme in the Midwestern USA. Residents were observed during 95 separate precepting interactions at four ambulatory sites.

Approach Using a qualitative approach, we analysed transcripts and field notes of observed behaviours and interactions looking for themes of information exchange. Coders discussed themes which were refined using feedback from an interdisciplinary panel.

Results Four themes of information exchange behaviour emerged: (i) questioning behaviours that were used as part of the communication process in which the resident and attending doctor could reason together; (ii) searching behaviour of non-human knowledge sources occurred in a minority of precepting interactions; (iii) unsolicited knowledge offering and (iv) answering behaviours were important means of exchanging information.

Conclusions Most clinic interactions between resident and attending doctors relied heavily on spoken deliberation without resorting to the scientific literature or other published information resources. These observations suggest a range of factors that may moderate information exchange behaviour in the precepting context including relationships, space and efficiency. Future research should aim to more readily adapt information resources to the relationships and practice context of precepting.

Background

Ambulatory care activities comprise one-third of the 3-year internal medicine residency education in the USA. And despite the ascendancy of evidence-based medicine as a tool to gather reliable health information, with the exception of work by Ramos *et al.* [1], little evidence exists on how information seeking occurs during the real-time ambulatory precepting activity. Precepting is a dedicated educational activity involving patient care and teaching where resident doctors discuss care plans with supervising faculty doctors (called, ‘attendings’). Studying this interaction can serve

as a window into how doctors (attendings and doctors-in-training called, ‘residents’) do or don’t obtain and integrate health information into their practice.

Previous studies of information seeking in private practice and other contexts by Woolf & Benson [2], Stinson & Mueller [3], and Smith [4] indicate that information needs of practising doctors often go unmet. Various models of health information seeking have been formulated to explain those needs including those by Curley *et al.* [5] and Gruppen *et al.* [6], revealing several consistent influencing factors, including access, habit, reliability, quality, speed and applicability of resource use recently summarized by Dawes &

Sampson [7]. However, it is not clear whether these factors apply to the same degree in contemporary ambulatory teaching contexts for the following reasons. First, many crucial studies examining information seeking occurred in the early and mid 1990s when computer-based information systems were just emerging in health care. Second, studies that focus on primary care specialties other than internal medicine (e.g. family practice or paediatrics) may have different expectations about behaviours during precepting. Finally, inpatient work practices and team dynamics may significantly alter the information retrieval process, making studies from the hospital setting difficult to generalize to ambulatory care.

Work by Greenhalgh *et al.* [8], Rousseau *et al.* [9], Montori *et al.* [10] and Ely *et al.* [11] have suggested that evaluating information search and retrieval processes may benefit from qualitative approaches. Ramos *et al.* [1] and Forsythe *et al.* [12] cite a lack of verbatim audiotaped data as a limitation in their attempts to study real-time information-seeking behaviour, especially in the clinical teaching environment. In an era when competency and accountability must be demonstrated, educators would ideally gather valid baseline descriptions about how doctors interact with their existing knowledge resources, combine that data with existing theory of information seeking and methods of scientific inference (e.g. clinical epidemiology), before devising educational interventions in this domain.

Using semi-structured observation and audiotaped techniques, this study sought to observe and characterize the information exchange behaviour of doctors in the ambulatory setting as a means of better understanding the range of contextual and behavioural factors involved in seeking out and utilizing health information in ambulatory residency training. We hypothesized that information exchange behaviours in this setting were common, but that they occurred within the human precepting relationship, and that search of non-human knowledge resources occurred rarely.

Study design

Setting

We observed and audiotaped general internal medicine resident-attending precepting interactions at four outpatient centres affiliated with a university-based internal medicine training programme in the Midwestern USA in October 2001. In these clinics, precepting interactions take place in dedicated educational spaces called 'mentor rooms' where various information resources, chairs and tables are assembled (Fig. 1). At the time the study was conducted, information resources and computers were not available in the other areas of the clinics. We defined a *precepting interaction* as the entirety of the resident's experience in the mentor room for one patient case.

Each precepting attending supervises two or three residents. In this setting, resident doctors conduct weekly continuity ambulatory primary care, where patients are scheduled every 30 minutes. Attending doctors accompany all first year residents back to the patient room during the first 6 months of clinic and at their discretion after 6 months. In this training programme, the precepting expectation is that all new patient cases, and the vast majority of returning patient cases be presented to the attending completely using an accepted approach (chief complaint, history of present illness, past medical history, allergies, social and family history,

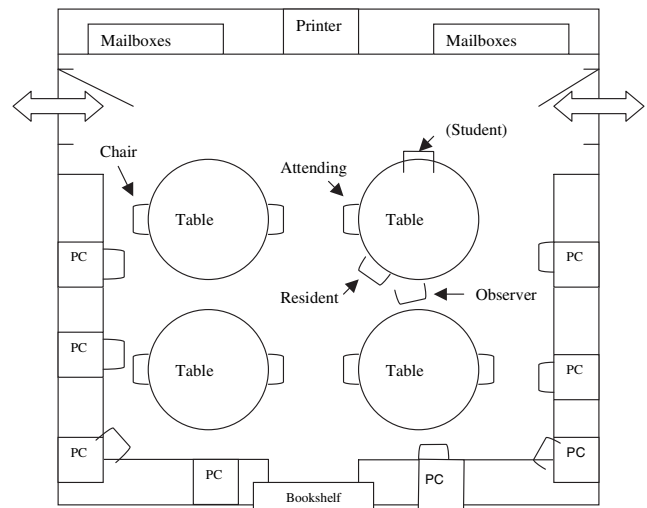


Figure 1 Clinic mentor room. Model of a large typical clinic mentor room with tables centrally surrounded by resources, chairs, personal computers (PC), and doorways (double-sided arrows) depicting the flow of traffic in and out of the mentor room. All locations included in the study used the space described above or a space with the same general features, furniture and resources.

exam, data, and assessment and plan). When senior residents (in their third and final year of training) are managing stable patients with whom faculty are familiar or when faculty patients are scheduled to see residents assigned to that faculty member, presentation of cases may be more abbreviated. Typically, clinic attendings in this programme do not schedule their own patients for visits during precepting time.

Data collection and management

Our observer, a recent medical graduate of the residency program's parent medical school, had training in medical informatics, knew the study setting well but was not well known to residents and was not pursuing a career in primary care. She observed residents in half-day increments, recording data using audio tapes and scribing field notes of observations consistent with a participant observation approach outlined by Bernard [13].

We sampled residents from eligible clinic sessions – any half-day weekly resident clinic session at a site that was large enough to use a mentor room. Successive sessions were observed until the end of the observation period. Residents were observed in isolation and sequentially from the time of entry into the mentor room after seeing a patient, through the precepting interaction, until leaving the room. All relevant clinical management behaviour during each resident's mentor room experience was observed for a given patient case.

Observer field notes focused on all information exchange behaviour between resident doctors, precepting attending doctors, and other information resources in the mentor room, defined as any behaviour seeking or receiving information for patient management. The observer used a field-tested, semistructured instrument developed in collaboration with three of the investigators (JT, SDG, RM). Field notes were transcribed and merged with

transcripts of audio recordings from each precepting interaction. For those audio tapes that were inaudible (11 tapes), field notes alone were used. We used N5[®], a qualitative data software system, to store transcripts and assist with data analysis.

Participants

Among all programme residents ($n = 147$), 54 (36.7%) were excluded for one of several reasons and four refused to participate (3.8%). We excluded those who we observed during piloting sessions ($n = 8$). Twenty-five residents were excluded for logistical complications with an affiliated clinic site, one resident because of previous knowledge of the research hypothesis, eight because there was no mentor room at their clinic, and 12 residents were absent either owing to exempting clinical commitments, vacation or maternity leave. Of the 89 remaining eligible residents, we observed 70 over a 1-month period during 17 of a possible 21 half-day clinic sessions in 95 precepting interactions at four sites. This number of residents was both consistent with our sampling goals and the maximum feasible number of observations given the observer's schedule.

Analytic approach

Three investigators initially read transcripts and field notes to gain a general familiarity with the transcript content. Consensus and revision of themes culminated in a codebook that included definitions, examples and inclusion/exclusion criteria for particular themes. All documents were analysed by at least one investigator using the codebook in its final version. All other steps in data analysis (open coding, initial coding, consensus, revision, code book construction, extraction of themes) involved at least two investigators.

Trustworthiness

Calibration of the observational technique occurred at two time points using a second observer. Recorded information exchange events were categorized as having complete agreement (described by both observers using essentially the same language), near agreement (similar language), or no agreement. Substantive agreement between the two observers [(complete + near agreement)/total information exchange events] was 75% and 85% in the first and second sessions respectively.

We insured trustworthiness of our interpretation by involving multiple investigators in each phase of the analysis, soliciting feedback from experts, and examining coherence with existing theory on learning behaviours. In addition, two investigators analysed a subset (10%) of merged documents from the initial coding phase, revealing substantive agreement in 64% (79/124) of recorded events. The coding scheme was reviewed with eight social scientists and educators through a convened research-in-progress session where several randomly selected observation text passages were presented and an initial coding scheme with examples was discussed in detail. Their primary task was to review and revise our initial thematic schema. With this feedback, the revised coding scheme was then calibrated against the social science literature for plausibility, resulting in a codebook that was then used to analyse all 95 merged transcript documents. This study was

reviewed and approved by the University of Michigan Health System's Institutional Review Board.

Results

Demographic characteristics of the participating residents and attendings did not differ significantly from all residents and attendings in the programme (Table 1). Interpretation of observation data using the reflective methodology outlined above revealed four themes of information exchange behaviour for ambulatory precepting: (i) questioning behaviour, (ii) searching behaviour, (iii) unsolicited knowledge offering, and (iv) answering behaviour. Table 2 describes the relative frequencies of the themes by transcript number, number of observed doctors exhibiting the behaviour, and coded text units. Interpretation of the themes follow.

Theme 1: Questioning behaviour

'Questioning behaviour', as a category, included any behaviour expressing a lack of knowledge to or seeking knowledge from the partner in the mentoring interaction. We further subcoded all questions into three subthemes by degree of explicitness: classic interrogative statements, expressed knowledge deficits, or interrogative gestures. See Table 3 for descriptions and examples of each subtheme.

Subtheme: Classic interrogative statements

In their most straightforward and easily recognized formulation, questioning behaviours were most often expressed as 'Classic

Table 1 Participant characteristics

Characteristics	Resident characteristics*	
	Residency population ($n = 147$)	Participating residents ($n = 70$)
Men (%)	102 (69%)	48 (69%), $P = 1.00$
PGY 1 (%)	53 (36%)	28 (40%), $P = 0.55$
PGY 2 (%)	44 (30%)	19 (27%), $P = 0.65$
PGY 3 (%)	44 (30%)	21 (30%), $P = 1.00$
PGY 4 (%)	6 (4%)	2 (3%), $P = 0.71$
Characteristics	Faculty characteristics [†]	
	Faculty population ($n = 29$)	Participating faculty ($n = 21$)
Mean age in years (SD)	40 (6.1)	40 (5.3)
Number of Males (%)	19 (66%)	14 (67%)
Mean years of precepting (SD)	9.0 (5.1)	9.4 (4.9)
Years out of medical school (SD)	13.3 (5.4)	13.6 (4.9)

* P -values represent tests of equality of means or proportions between participants and their respective population.

[†]Twenty-nine of 34 attendings from the programme responded to a survey to ascertain group characteristics. Twenty-one of those 28 participating faculty responded to the survey. PGY, post-graduate year.

Table 2 Frequency of information exchange behaviours

Behaviour themes	Transcripts containing* (n = 95), n (%)	Coded text units† (n = 4367), n (%)	Attendings exhibiting‡ (n = 28), n (%)	Residents exhibiting§ (n = 70), n (%)
Questions	94 (99)	1030 (24)	29 (100)	56 (80)
Interrogative statement	87 (92)	900 (21)	–	–
Structured clinical	18 (19)	64 (1)	–	–
Knowledge deficit	36 (38)	119 (3)	–	–
Interrogative gesture	7 (7)	11 (0.2)	–	–
Searching	25 (26)	66 (2)	9 (31)	15 (21)
Unsolicited knowledge offering	86 (91)	1853 (42)	29 (100)	49 (70)
Answering	94 (99)	1418 (32)	26 (90)	69 (99)

*Number of transcripts containing the information exchange behaviour listed; each transcript describes a single precepting interaction.

†Number of text units (i.e. lines of text) coded by each of these categories.

‡Number of attendings who exhibited these behaviours.

§Number of residents who exhibited these behaviours.

Table 3 Examples of questioning behaviour

Question subtype	Case context	Statement syntax	Data (coded text in italics)
Classic interrogative	Pharyngitis case	Interrogative	ATT: It's amazing that it works.
			RES: <i>Why does that work?</i>
Learning	Diabetic with borderline hypertension		ATT: I don't know. One of the things that we've been handed down from mother to child . . .
			RES: I know it's really rare to see strep in adults. <i>Do you ever look for that?</i>
Teaching	Fatigue		ATT: What is the degree of blood pressure control that we're shooting for here, do you think?
			ATT: Five things that cause fatigue. <i>What are the five things that cause fatigue?</i>
Immediate need	Treatment of respiratory infection		RES: Are people giving 'Azithro' 500 milligrams for 5 days now? Isn't that the recommendation for community-acquired pneumonia?
Expressed knowledge deficit	Further evaluation of renal function	Declarative	RES: The renal function sort of stabilized at one point. <i>I'm not sure what to do about that.</i>
	Tentative plan		RES: <i>I'm just, I want to be real smart about the thyroid test I need before I do it, but I'm thinking Free T4, TSH and, I don't know if I'm going to learn a lot more from any other of her tests.</i>
Reasoning out loud	Further evaluation for chronic pancreatitis and abdominal pain syndrome		ATT: We thought all along that the guy has other issues related to this. But I don't think we've considered anything other than that he has this pain syndrome that's unclear to us what's causing it.
			RES: Right.
Lack of specificity	Work-up of thyroid problem		ATT: He's had a pretty good work-up. <i>I don't know what else we can do for him.</i>
			RES: <i>I don't either, especially from a GI perspective. He's gotten everything.</i>
Interrogative gesture	Work-up of syncope	None	RES: There's this question I have, which, I guess I can look it up, I can form a clinical question. But she has lid lag. I mean it's got to be completely non-specific, at least hers is, but I'm just kind of curious on that . . .
			Field notes: <i>When resident responds to type of stress test, sounds like a guess (voice hesitant, questioning)</i>

ATT, attending doctor; RES, resident.

Interrogative Statements', ranging from simple to more sophisticated. These short, direct questions filled in defined knowledge gaps quickly for residents or were used by attendings to rapidly orient the resident to common salient information in ambulatory care. Classic interrogative statements frequently sought to reinforce background knowledge about basic physiology, clarified the management of the patient to date or solicited general opinion about what the attending's experience had been. Questions were phrased informally, but addressed an immediate information need. Formal structured clinical questions, such as those advocated by proponents of evidence-based medicine [14,15], were stated in a minority of precepting interactions (18 of 95 interactions).

Subthemes: Expressed knowledge deficits and interrogative gestures

'Expressed knowledge deficits' conveyed a lack of knowledge or uncertainty in the form of a declarative (rather than interrogative) statement. We included these expressions in the 'Questioning behaviour' category despite this syntax. For instance, a resident presenting several ongoing medical issues mentioned that the kidney function was abnormal but stated that he was not sure what that meant. In other instances, trainees expressed a *tentative management plan*, but made it clear that their inclination to implement that plan was uncertain. Still, other times, these expressed knowledge deficits were attempts to *reason out loud* about the nuances of patient management, often for chronic poorly explained symptoms. Finally, we identified 'Interrogative gestures': resident behaviour, mannerisms, and intonations that also implied a need for knowledge. This last subtheme was the subtlest and least common questioning behaviour observed.

Theme 2: Searching behaviour

We defined 'Searching' as *behaviours seeking information from a non-human knowledge resource*. When searches for patient-specific data from the medical record were excluded, we found a total of 42 individual searches in 25 of the precepting interactions. Eighteen of the searches were conducted purely for drug dosing clarification, while 24 were targeted at in-depth clinical management problems.

When observed doctors used these resources, they usually searched either hand-held manuals (18 of 42 searches) or personal digital assistants (PDA, 10 of 42 searches). Two searches involved UpToDate© (that was readily available to all trainees). Only one search involved the MEDLINE database.

When deciding on an information resource, residents and attendings generally first turned to those resources physically closest to them, moving away from the mentoring table after the resources at hand had been attempted. This behaviour is demonstrated in the field notes below.

Field notes

Resident mentions she can't find Vasocydin dose in Pharmacopeia. Attending takes out PDA and at same time, resident takes out Harriet Lane – both look up Vasocydin.

Attending leaves mentor room to look for PDR©.

Attending returns, asks resident if she can find Vasocydin online.

Another resident suggests looking at Micromedex©.

Resident pulls up Micromedex© and finds medicine –

Attending looking over resident shoulder at computer screen and advises which dose to pick.

Doctors left their physical position to search a knowledge source in 14 out of the 42 recorded search behaviours.

Frequently, service commitments and time pressures were observed in direct association with resident searching behaviour.

Field notes

Resident seems to be about to look something up but [apparently] doesn't have time because attending finishes conversation with medical assistant.

In this example, the attending had initially interrupted dialogue with the resident to resolve another issue he had been addressing with a medical assistant. When the attending resumed his conversation with the resident, the resident aborted her own search to discuss the case with the attending. However, aborted searches were observed in only a small minority of interactions that did not contain explicit searches.

Theme 3: answers

We defined 'Answers' as *direct responses to a question*. Answers were expressed in the vast majority of transcripts (99%) and in a variety of styles depending on (i) the role the answerer played (resident or attending) and (ii) the complexity of the clinical content.

Answers from residents often conveyed their reasoning, clarified information about the patient's management, or expressed potential uncertainty in response to attending questioning (see examples provided in Table 4). In many such instances the question and answer dynamics between residents and attendings were an iterative way to focus shared clinical reasoning. Answers from attendings were often used for teaching. Attendings frequently not only conveyed clinical knowledge, but also (what seemed to us as) a style of clinical judgement and knowledge of the literature related to the immediate clinical questions. In addition, attending answers used different linguistic devices such as metaphor, simile, and storytelling (Table 4).

Theme 4: Unsolicited knowledge offering

We also notice a significant number of non-'Question', non-'Answer' dialogue excerpts that resembled 'Answers', but were not preceded by a 'Question.' We labelled these as Unsolicited knowledge offering, defined as any knowledge conveyed regarding patient management that was not in response to a question (and was not simply conveying or clarifying patient data). These behaviours displayed some of the same diversity seen in Answers, and included some styles not found in Answers. This category included information exchange that was usually initiated by the attending, offered without citing references, yet was immediately relevant to patient management. We observed many formats of this behaviour, including advice-giving, articulation of a plan, commentary, medical knowledge and sharing personal experience (Table 5).

Table 4 Examples of answering behaviour

Answering behaviour	Example (coded text in italics)
Convey reasoning	ATT: What are you thinking? RES: <i>Well, it could be a lot of things. But it sounds like she's been treated for all the most common things. I mean, nothing helps.</i>
Didactic vehicle	RES: What do you feel about checking out a chest x-ray on him? (Question) ATT: Some of it depends how suspicious the cough is. If it's just sort of one of these dry, nagging coughs, he's not bringing up a lot of sputum, that he's not short of breath or increasing just beyond exertion, then it doesn't sound like COPD . . . The issue on the horizon now are these studies that have come out of Europe, and particularly the UK, about rapid CT as a new screening approach for heavy smokers (Answer).
Linguistic devices	
Metaphor	ATT: <i>However, if there are [hoofprints] and there's bad breath in your face and you look up and say that's just a horse, I don't think I need to examine that horse, that will be fine.</i>
Simile	ATT: <i>It's like toothpaste. Which brand works for you . . .</i>
Storytelling	ATT: <i>He's always been a wheezy kid from day one . . . I mean, at one point, he had pulmonary oedema . . . I was seeing him so many times . . . He's never had an ear infection that I know of and I just have never seen his ears because I can't ever get down there.</i>

ATT, attending doctor; RES, resident.

Table 5 Styles of unsolicited knowledge offering

Style	Quote
Advice giving	ATT: You know, the other thing is if she's, you know. in a woman like this, I think if we start a whole bunch of medications at once, she's going to get confused. She's going to get irritated.
Articulation of plan	ATT: And you could even dictate if he ends up developing rhinorrhea that's green, he can call back in for antibiotics.
Behavioural commentary	ATT: Basically, she has a severe personality disorder. and this is the way she interacts with the world; this is how she lives her life. This is how she sort of identified her life and how she interacts with people. She probably almost has no friends, right?
Sharing personal experience	ATT: Gargling with warm salt water helps much more than it sounds like it will. I certainly use that myself. You just put a handful of salt water, basically as much salt as you can get to dissolve in the water, and the water as hot as your tap will run it. and then you gargle it and spit. You don't swallow. (file 3)
Citation/referencing	ATT says 'let's take care of the coughing first'. Then goes on to give details about managed care guidelines and how to treat this pt. (file 20)
Medical knowledge	ATT: Most important, probably, is travellers' precautions. [If] you can't boil it or peel it, don't eat it. Boil it, bake it, peel it, I guess. And, make sure she knows about ice cubes. Bottle water is generally safe, although, in many countries, they recycle water because tourists all drink the water. and so, if she want to, get water in bottles with the unbroken seal. (file 48)

ATT, attending doctor; RES, resident.

Discussion

We set out to characterize real-time information exchange behaviour in the ambulatory internal medicine training environment using direct observation and audiotaped data collection techniques. We found that, in most precepting interactions, doctors relied heavily on the spoken deliberation process between resident and attending without resorting to the primary scientific literature or other non-human knowledge sources. In our estimation the first two themes, questioning behaviour and searching behaviour are most crucial to understanding information exchange behaviour in this setting. Questioning behaviour was used both by residents and attendings as a means of gathering information either for their own

knowledge, to assess the learner, or to facilitate a decision at the point of care. Furthermore, searching behaviour seemed to arise out of a mutual need for more information and focused on resources that were nearby. Like information seeking in other professional contexts, these interactions were shaped by emergent, dynamic components of the precepting interaction and struck a balance between planned and unplanned aspects of information seeking as described by Ng [16]. These results are important for understanding the role of information resources in the precepting relationship which transpires in a specific context – the mentor room. By extension these results suggest implications for how information resource use can be improved in ambulatory training settings.

Importance of the precepting relationship

Attendings

When we observed attendings' dialogue (including questioning behaviour), we were observing teaching *at the point of care*. However, that role as teacher (and by extension, informal knowledge source) may at times discourage formal information seeking: These dynamics may demonstrate aspects of power and interpersonal expectations, as well as socializing forces that may add important constraints to information retrieval described in the work of Mignerey *et al.* [17] and Knobloch & Solomon [18]. Furthermore, in the precepting setting we observed, computer-based searches were associated with physically turning away from the other doctor. While far from proving a causal relationship, this association raises the question of whether residents implicitly avoid turning away from an attending to search, subconsciously giving priority to the spoken interaction with the authority figure. When viewed from within the precepting relationship, the human-oriented information-seeking behaviour and lack of searching of non-human resources that were observed becomes understandable.

Residents

Residents rely on attending doctors to provide information in precepting. This is its own kind of information-seeking behaviour described by Weinberg *et al.* [19]. The social expectation in precepting that attendings personally deliver important information may mean no further explicit statement of information need or subsequent information seeking is typically required. Perhaps only when both the attending and resident encounter a clinical issue that is foreign to their shared experience, described as a 'dilemma' by Timpka & Arborelius [20] will an explicit question need to be articulated and a more formal search process ensue. Under usual circumstances, we observed that the uncertainty of decisions was handled informally without a structured information-seeking process. Wilson *et al.* [21] have found that uncertainty is an important variable in a problem-solving model of information seeking. Our data are consistent with those previous observations. Furthermore, we suspect the way that uncertainty is communicated, detected and interpreted may be important for information seeking in the ambulatory precepting context. Finally, some shortcuts to coping with uncertainty may discourage formal information seeking and accurate problem solving.

Importance of the precepting context

The context of the mentor room not only includes a variety of social roles, expectations and dynamics, but also time and space factors that may shape information exchange behaviour.

Attending-resident precepting, as described in this study, occurs with patients scheduled every 30 minutes, one attending for every two or three residents, and competing communication with other members of the staff. This raises the possibility of trade-offs between efficiency of clinical practice (e.g. being on time for the next patient), and comprehensive, conscientious, up-to-date clinical care. Thus, time may represent a 'resource cost' in the precept-

ing information exchange behaviour we observed just as Woolf & Benson [2] described.

In the training programme we studied, doctors discuss patient cases at a central table in the mentor room, which is usually 5–10 feet from the nearest computer and print resources (Fig. 1). Searching of non-human resources were used more frequently with at-hand resources (e.g. PDA's, pocket manuals). As Ng [16] observed, these findings also raise the possibility that ease of use and accessibility may influence information seeking in this context.

Implications for residency training

Seeking out and applying reliable evidence-based information are keys to improving competency in practice-based learning and medical knowledge, as called for in the USA by the Accreditation Council for Graduate Medical Education's [22] core competencies. As Fidel & Green [23] as well as Leckie *et al.* [24] have found in studies of practising doctors and other professionals, these descriptive findings prompt us to hypothesize that efficiency and convenience may be equally important mediating factors for trainees' use of information.

By extension, more attention may need to be paid to the user end of information resources in the practice context of trainees. Specifically, educators should attempt to deliberately connect doctors-in-training to the right information resources *in context* – a prescription for effective information delivery. Such an information prescription, would devote attention not only to high quality resources, but customize the *right information* to the doctor's needs at the right time and in the right place given the strengths, weaknesses and preferences of the particular attending-resident pair. We suspect, for instance, that summaries of the best evidence that are linked with the patient's current problem list within an electronic medical record may be one attractive way to facilitate evidence-based information access while preserving the relational and contextual aspects of current precepting practice. This would bring a more refined, systems-based approach to integrating evidence into practice, as advocated by Haynes [25]. Such easily accessible, concise, and current medical information may more readily guide clinical decision making while accepting the logistical and interpersonal realities of ambulatory care. Increasing facility with at-hand resources, we suspect, may also prepare residents to enter practice where learning-oriented precepting interactions no longer occur. Accomplishing this enhanced information prescription while preserving the admirable relational qualities of precepting as a teaching practice should be the goal of informatics education in ambulatory residency training for the future. As leaders seek to transform ambulatory education, integrating information technology into the human elements of practice will hopefully enhance the quality of internal medicine training in this setting.

Limitations

There are some limitations to our study. First, we did not debrief participants about their information exchange behaviour – a process referred to as 'member checking' ($n = 14$). We specifically avoided member checking for fear that awareness of our study hypotheses and objectives would contaminate the environment we were trying to observe over a 1-month study period. This means

we are limited in making inferences about which specific factors were most influential in explaining the individual behaviours we observed. For instance, this study cannot address other potentially relevant non-human factors such as resource characteristics (usability, relevance and trust) that may contribute to the frequency of information exchange behaviour we observed. Second, the study took place relatively early in the academic year, which means that many of the first year residents had not yet received formal instruction on optimal informatics resources and search techniques. Furthermore, we recognize that this study sampled from one large, academic residency programme. Therefore, applying the results to specific residency programmes with different population characteristics and precepting arrangements may be limited.

Importantly, in the interval time since this study was conducted, the pace of technological innovation for information seeking in clinical practice has grown. These developments include, for example, the evolution of wireless technology and the expansion of clinical knowledge databases in hand-held form. These developments may have changed the format and content of resources available to doctors-in-training, compared with the time of our study. However, we suspect the themes of information exchange behaviour that this study addresses remain relevant and timely in the current educational context.

Despite these limitations, we believe this study provides a realistic and detailed description of information exchange behaviour and its relevance for precepting in internal medicine training contexts.

Conclusions

Information exchange behaviour in the ambulatory clinical training context seems to reflect many of the same themes echoed in the literature on information seeking. Our observations can provide relevant baseline descriptions of these behaviours. This description can inform the design of more realistic interventions to improve doctor interactions with their knowledge resources during ambulatory precepting.

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