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Utility of the electronic information resource UpToDate for clinical decision-making at bedside rounds

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INTRODUCTION Clinical questions often arise at daily hospital bedside rounds. Yet, little information exists on how the search for answers may be facilitated. The aim of this prospective study was, therefore, to evaluate the overall utility, including the feasibility and usefulness of incorporating searches of UpToDate, a popular online information resource, into rounds.

METHODS Doctors searched UpToDate for any unresolved clinical questions during rounds for patients in general medicine and respiratory wards, and in the medical intensive care unit of a tertiary teaching hospital. The nature of the questions and the results of the searches were recorded. Searches were deemed feasible if they were completed during the rounds and useful if they provided a satisfactory answer.

RESULTS A total of 157 UpToDate searches were performed during the study period. Questions were raised by all ranks of clinicians from junior doctors to consultants. The searches were feasible and performed immediately during rounds 44% of the time. Each search took a median of three minutes (first quartile: two minutes, third quartile: five minutes). UpToDate provided a useful and satisfactory answer 75% of the time, a partial answer 17% of the time and no answer 9% of the time. It led to a change in investigations, diagnosis or management 37% of the time, confirmed what was originally known or planned 38% of the time and had no effect 25% of the time.

CONCLUSION Incorporating UpToDate searches into daily bedside rounds was feasible and useful in clinical decision-making.

Keywords: beside rounds, clinical decision making, education, electronic information resource, UpToDate
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INTRODUCTION

Physicians today are faced with a staggering amount of information from the medical literature when making clinical decisions during busy daily bedside rounds.[1] Many barriers, including suboptimal curricula in residency programmes,[2] prevent these physicians from practising evidence-based medicine (EBM).[3,4] Although clinically-integrated teaching is more effective than didactic teaching,[5,6] opportunities for learning are often lost during these rounds, when the sickest patients are seen.[7] More than ten years ago, Sackett and Straus showed that clinical questions often arose during bedside rounds, and that these questions could be answered by providing physicians with a cart containing various information resources.[8] However, as it was cumbersome to wheel this cart along ward corridors, it was left inside the team meeting room for rounds. Newer methods to answer unresolved clinical questions during bedside rounds are therefore in demand.

Over the last decade, concurrent with the advent of health information technology,[9,10] another tool called UpToDate (UpToDate Inc, Waltham, MA, USA) has emerged as one of the most popular information resources for physicians and clerks.[11-16] UpToDate is essentially an electronic textbook with a search engine, which provides reviews written by leading physicians on diverse topics in internal medicine, paediatrics, obstetrics and gynaecology and family medicine, and which can be accessed on the internet, compact discs or personal digital assistants. Our own recent studies have also revealed much enthusiasm for UpToDate among our hospital's doctors.[17,18] The use of portable computers with rapid wireless internet access at our patients' bedside has enabled doctors to utilise this resource in real time for clinical decision-making. However, to the best of our knowledge, no information exists on the impact of UpToDate on clinical decision-making during bedside rounds. We therefore conducted a prospective study on the use of UpToDate at rounds. The aim of the study was to evaluate the overall utility, including the feasibility and usefulness of this practice for answering unresolved clinical questions.

METHODS

In May 2007, our university hospital's Division of Respiratory and Critical Care Medicine implemented a multifaceted long-term and ongoing quality improvement programme to enhance clinical decision-making among our doctors. Part of this effort involved the use of information technology resources. This study evaluates this aspect of the programme and was conducted between September and November 2007. The Division functions with two clinical teams comprising consultants, associate consultants, registrars, medical officers (at least one year postgraduation) and house

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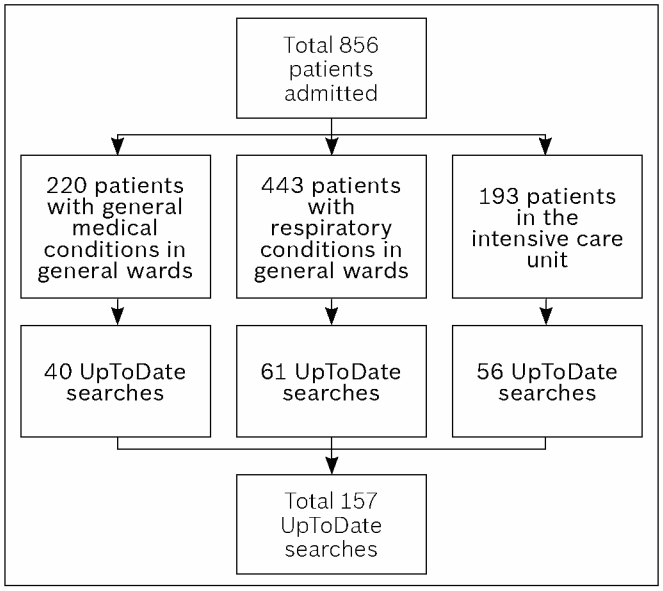

Fig. 1. Flow diagram shows UpToDate searches for admitted patients.

officers (less than one year postgraduation). One team sees patients in the general wards with general medical or respiratory conditions. The other team works in the medical intensive care unit.

Before the study period, the principal investigator (JP) gave a half-hour briefing to all doctors in the clinical teams about the rationale behind and the details of the study. During the briefing, all doctors were urged to ask the following question for each patient at daily formal bedside rounds: "Are there any unresolved questions for which we need more clinical evidence or information?" This question was reiterated on standardised hardcopy data entry forms that the clinical teams carried along during rounds. The doctors were encouraged to search UpToDate for any unresolved questions, preferably during rounds, especially if the answer was urgently needed or if time permitted. As no conditions were specified for the degree of doubt before the use of UpToDate, searches could be performed either to confirm the doctors' prior suspicions, or when they had no prior knowledge. So as not to disrupt the rounds, the study did not mandate who would perform the search. Internet access including UpToDate, for which the hospital has had an institutional subscription since 2004, was accessible on all ward computers, including computers on wheels that were pushed around by the clinical teams during rounds. While the doctors were familiar with the use of the internet, those who were not familiar with UpToDate were orientated to its use during the briefing through one-to-one demonstration and hands-on practice.

The results of the search, including questions on its feasibility and usefulness, were recorded on the data entry forms immediately after the search. The study did not mandate who would record the data. The completed forms were returned to the investigators at the end of every week. The UpToDate search was considered feasible if the clinical teams could perform and complete the search during the rounds. This was based on the literal definition of 'feasible', i.e. 'capable of being done, executed, or effected'.[19] The actual question and the answer, if found, were recorded. The most senior doctor within the clinical teams at any one time, usually a consultant, associate consultant or registrar, was instructed to use a stopwatch to ensure that the time taken to complete the search was accurately recorded, as defined by arriving either at an answer or a decision that further search was futile. The UpToDate search was considered useful if it provided a satisfactory answer. A 'satisfactory answer' was defined as one that the clinical team deemed had addressed their original question. A 'partial answer' was defined as one that only partially addressed the question, while 'no answer' was chosen if the search could not even partially address the question.

The clinical teams recorded how the UpToDate search affected the doctors' arrived diagnosis, investigations performed and clinical management, i.e. whether the search led to a change in any of these aspects, or merely confirmed what was originally known or planned, or worst, had no effect whatsoever. The effect of UpToDate searches on the doctors' knowledge of symptoms and signs was also recorded. If other information resources were used after searching UpToDate, these were recorded too. The teams had online access to several core general medicine journals through a hospital-wide subscription to OVID (including the *New England Journal of Medicine*, *Journal of the American Medical Association*, *The Lancet*, *Annals of Internal Medicine* and *British Medical Journal*), and to several respiratory and critical care medicine journals using the Division's own subscriptions (including the *American Journal of Respiratory and Critical Care Medicine* and *Critical Care Medicine*). An electronic folder containing the consultants' and associate consultants' personal collections of review and original articles on respiratory and critical care medicine topics was also downloaded onto all ward computers for reference and updated at least monthly.

Variables were expressed as frequencies (including how often the searches were deemed feasible and useful) and median (first quartile, third quartile). The questions raised were grouped into various categories according to their nature at the end of the study period. Groups were compared using the chi-square test and the Mann-Whitney U test where applicable. In line with the classification by Singapore's Specialists Accreditation Board, registrars, medical officers and house officers were grouped together as trainees, and consultants and associate consultants were grouped together as specialists. A $p < 0.05$ was considered statistically significant, with all p-values being two-sided. Data were analysed using the Statistical Package for the Social Sciences version 11.5 (SPSS Inc, Chicago, IL, USA). In our hospital, quality improvement surveys on educational practices such as this are exempted from a formal ethics review by the institutional review board.

RESULTS

During the study period, a total of 856 patients were admitted, and a total of 157 UpToDate searches were made (Fig. 1). Most questions focused on clinical management, followed by investigations, manifestations of diseases, prognosis and pathophysiology (Table I). A total of 27 doctors raised questions:

Table I. Categories of questions asked.

Focus of question	Example	No. of questions (%)
Pathophysiology	What causes hyponatraemia in cirrhosis?	1 (1)
Manifestations of disease	What are the neurological manifestations of microscopic polyangiitis?	23 (15)
Investigations		
General	How does one investigate hypercalcaemia?	7 (4)
Specific	What culture medium is used for melioidosis?	26 (17)
Management		
General	How does one manage abdominal compartment syndrome?	13 (8)
Specific	When are antibiotics indicated in chronic obstructive pulmonary disease?	45 (29)
Drug dose	What is the dose of levofloxacin in chronic kidney disease?	25 (16)
Drug side effects	Can valproate toxicity cause acute respiratory distress syndrome?	15 (10)
Prognosis	What is the prognosis of tuberculous meningitis?	2 (1)

Total no. of searches: 157

Table II. Doctors who raised questions and performed UpToDate searches.

Demographic	No. of questions (%)				
	House Officer	Medical Officer	Registrar	Associate Consultant	Consultant
Doctor who raised questions	6 (4)	49 (31)	43 (27)	41 (26)	18 (12)
Most senior doctor present when questions were raised	0 (0)	7 (5)	48 (31)	61 (39)	41 (26)
Doctor who performed UpToDate search	29 (19)	53 (34)	27 (17)	42 (27)	6 (4)

Total no. of searches: 157

five consultants, two associate consultants, four registrars, 13 medical officers and three house officers. The questions were most often raised by medical officers, registrars and associate consultants (Table II). Consultants and associate consultants were present approximately two-thirds of the time when the questions were raised. The UpToDate searches were mostly done by medical officers.

Overall, the searches were feasible and performed during rounds 44% of the time. They were performed after rounds 56% of the time. When questions were raised by specialists (consultants and associate consultants), searches were performed during rounds 61% of the time, as opposed to 34% of the time when raised by trainees (registrars, medical officers and house officers) ($p = 0.001$). The median time taken per search was three minutes (two minutes, five minutes). This time was not affected by who raised the question or searched UpToDate ($p > 0.05$).UpToDate was useful and provided a satisfactory answer versus a partial answer and no answer 75%, 17% and 9% of the time, respectively. Whether or not a satisfactory answer was obtained from UpToDate was not affected by whether trainees or specialists raised the question or performed the search ($p > 0.05$).

While UpToDate had relatively little impact on the investigations ordered and the diagnoses made, it changed management 30% of the time (Fig. 2), e.g. the institution and withdrawal of certain therapies based on the medical evidence quoted in UpToDate and changes in doses of medications. Overall, it led to a change in investigations, diagnosis or management 37% of the time, was confirmatory 38% of the time and had no effect 25% of the time (Fig. 2). UpToDate improved knowledge of the symptoms and signs of illnesses 32% of the time. Searches for specialists' questions improved such knowledge 20% of the time, as opposed to 39% for trainees' questions ($p = 0.02$). Table III shows the other information resources that were consulted after UpToDate searches. When UpToDate provided a satisfactory answer, these other resources were subsequently consulted only 4% of the time; when UpToDate provided only a partial or no answer, they were consulted 68% of the time ($p < 0.001$).

DISCUSSION

This study found that incorporating UpToDate searches into daily bedside rounds was often feasible and useful in addressing unresolved clinical questions. This has potential implications on the practice of EBM, the training of doctors, patient outcomes and healthcare costs. Although numerous clinical questions arise every day, physicians often do not pursue the answers to many of them,[20-22] either due to the lack of time or information resources.[3,4,20] Yet, since it is during daily bedside rounds that the sickest patients are seen, the importance of answering these questions and thereby potentially improving clinical outcomes cannot be underestimated.

In 1997, Sackett and Straus provided physicians with an evidence cart, which was essentially a trolley containing compact discs of MEDLINE and other libraries, and hardcopy and electronic textbooks and critically appraised topics.[8] However, as the cart was cumbersome to wheel around during rounds, progress in this area has stagnated since. It is thus clear that tools used to promote the practice of EBM should be relatively easy to use. Meanwhile, UpToDate, a regularly updated online textbook that summarises the latest clinical evidence, has emerged in recent years as arguably the most popular electronic information resource for self-learning by physicians and clerks.[12-18]

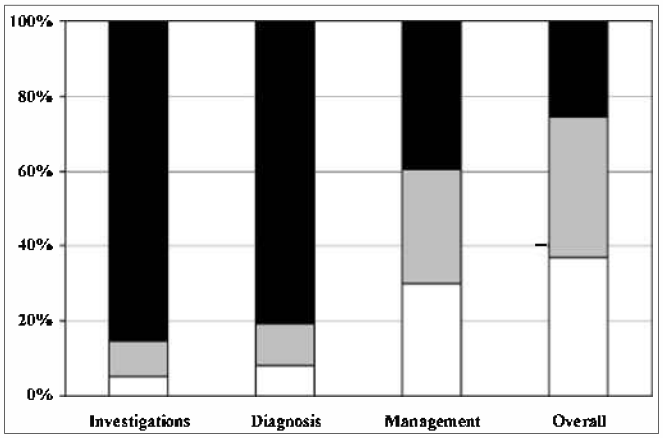

Fig. 2. Graph shows the effect of UpToDate searches on investigations, diagnosis and management. White bars represent the proportion of searches that changed or added to original investigations, diagnosis or management. Gray bars represent the proportion of searches that merely confirmed original investigations, diagnosis and management. Black bars represent the proportion of searches that had no effect.

Table III. Use of information resources other than UpToDate.

Resource	No.
Expert	
More experienced doctor	6
Pharmacist	4
Internet resource	
Google	12
PubMed	7
eMedicine	4
Online journal	2
Wikipedia	1
Yahoo!	1
Others	
Division's electronic folder of articles	3
Hardcopy medical textbook	2
Medical software on the personal digital assistant	1

*Refers to the number of times the resource was consulted.

Thus, we incorporated its use into bedside rounds hoping that it would help to address the problems of lack of time and information resources for EBM. To the best of our knowledge, such a team-based approach has not previously been reported.

It is encouraging that UpToDate searches were feasible and performed immediately during rounds 44% of the time, and that our clinical teams did use UpToDate fairly enthusiastically. This notwithstanding, some caveats to the use of such electronic resources for bedside rounds are highlighted by the fact that doctors waited until after the rounds to perform the searches 56% of the time. One reason for this would be to avoid holding back the rounds, even though most searches took only a short time, i.e. a median of three minutes, which was consistent with the timing reported by other investigators.[23,24] Although we did not compare the time taken to search UpToDate versus other information resources, previous studies have shown that doctors often limit their searches to less than two minutes.[21,22] Lack of time is a major reason why internal medicine residents do not search for evidence-based answers at hospital clinics.[20] Our findings suggest that the same situation arises at rounds, and even a relatively fast tool like UpToDate cannot solve the problem completely.

Feasibility issues aside, UpToDate searches proved useful and provided a satisfactory answer 75% of the time. The implementation of such a practice at rounds supplements traditional forms of bedside teaching and yields several potential benefits, especially for doctors in training. First, it encourages the habit of asking clinical questions. According to Ely et al who developed a taxonomy of questions about patient care, doctors most often asked questions about a disease's symptoms and management.[21,25] This was indeed what our study found, and UpToDate proved useful in these situations. Second, this practice equips them with the skills required to select an optimal search strategy for answers.[3,4] Indeed, for the 25% of questions that were not adequately answered by UpToDate, doctors went on to other (predominantly electronic) resources two-thirds of the time; this was more encouraging than what prior investigators have found.[20-22] Third, this practice adds to doctors' clinical knowledge. Interestingly, UpToDate added more to the knowledge (of the symptoms and signs of diseases) of trainees than specialists. This suggests that such resources that summarise the medical literature rather than provide primary evidence may be better suited for doctors in training. Importantly, our hospital's internal medicine residency programme was recently accredited by the Accreditation Council for Graduate Medical Education-International. Two of the core competencies expected of residents are medical knowledge and practice-based learning and improvement, both of which are facilitated by the use of UpToDate.

The benefits of using UpToDate at rounds extend beyond educating doctors. Information technology has become integral to the practice of medicine.[9,10] While complex systems such as electronic health records and computerised decision support tools can potentially be designed to help reduce the number of missed diagnoses, unnecessary investigations, incorrect management and other inadvertent human errors,[9] simpler and more user-friendly electronic tools like UpToDate may serve the same purposes. The net effect of programmes that employ various forms of information technology may be improved patient outcomes and healthcare efficiency, and decreased costs.[26,27] The wide availability of resources such as UpToDate should thus promote more research on this important question.

This study has several limitations. First, the Hawthorne effect (where subjects improve an aspect of their behaviour that was being experimentally measured simply in response to the fact that they are being studied[28]) cannot be excluded, i.e. because doctors were actively encouraged to ask relevant questions and search UpToDate, it is possible that the clinical teams might have gone the extra mile to comply, thus making these searches appear more feasible than they actually are. Indeed, it has been shown that studies of various forms of information technology are usually more successful when carried out by the teams with an interest in such technology.[29] Conversely, as the study focused on situations when UpToDate was actually searched, the number of times where no attempts were made to answer unresolved

clinical questions is unknown. Nevertheless, the study's findings do suggest that it is possible to implement a programme in which the use of UpToDate – or any other information resource – is encouraged and incorporated into routine clinical practice. Second, although what was meant by a "satisfactory answer" was pre-defined, the study's standardised data collection form had not been externally validated and a certain degree of subjectivity persisted. Accordingly, the possibility of bias toward recording positive results within the realms of a study and in the absence of an independent observer remained. Similarly, checks were not made on the accuracy of the recorded time taken to complete each search. Third, given that this was a relatively small single-centre study in a well-equipped tertiary hospital, our findings may not be readily applicable to other hospitals, where access to EBM tools such as UpToDate may remain a problem.[2,4] Fourth, we must emphasise that while our questionnaire survey evaluated the feasibility and usefulness of UpToDate searches at rounds, it does not seek to validate UpToDate as an accurate information resource with an impact on outcomes. In addition, we did not compare it with other resources such as OVID, PubMed or even Google.[23,24,30]

To conclude, incorporating UpToDate searches into daily bedside rounds was often feasible and useful in addressing unresolved clinical questions and assisting clinical decision-making. Despite barriers such as the lack of time, UpToDate searches were fast, provided a satisfactory answer most of the time and led to a change in investigations, diagnosis or management more than one-third of the time. Future studies should now evaluate if this IT tool could indeed result in decreased errors and improved patient outcomes. How UpToDate compares with other electronic search tools should also be assessed.

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