Tensions associated with the use of electronic knowledge resources within clinical decision-making processes: A multiple case study

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ABSTRACT

Content and objective: Health professionals now routinely use electronic knowledge resources (EKRs). Few studies have considered EKR-related tensions which may arise in a clinical decision-making context. The present study aims to explore three types of tension: (1) user–computer tension, (2) social tensions, and (3) organizational tensions (constraints associated with organizational routines and health policies).

Design, participants, intervention, setting: We conducted a multiple case study, examining Family Medicine residents' searches for information in everyday life. Cases were defined as critical searches for information among 17 first year family medicine residents using InfoRetriever® 2003/2004 on a PDA over 1.5 months at McGill University. InfoRetriever®- derived information was used within a resident-patient decision-making context in 84 of 156 cases. For each case, residents were interviewed, and extracts of interview transcripts were assigned to themes using specialized software (presence of tension; type of tension). Further computer-assisted lexical-semantic analysis was performed on transcripts. Authors reached consensus on assignments.

Results: Twenty-five cases with tension were identified (one case had two types of tension), and illustrate the above mentioned types of tensions: (T1) tension between the resident and InfoRetriever® (N = 16); (T2) InfoRetriever® -related tension between the resident and other social actors, specifically supervisors, other health care professionals and patients (N=7); (T3) InfoRetriever®-related tension between the resident and the health organization/system (N = 3).

Conclusions: Results suggest EKR usage in a clinical decision-making context may have negative

consequences when three types of tension arise in a clinical decision-making context. Illustrated types of tension are interrelated and not mutually exclusive. Awareness of EKR-related tensions may help clinicians to integrate EKRs in practice.

1. INTRODUCTION

Electronic knowledge resources (EKRs), in particular on a personal digital assistant (PDA), provide health professionals with rapid access to information. EKRs constitute a new means to support clinical decision making when they provide relevant and valid information. Benefits of using EKRs include improved effectiveness and efficiency of health care delivery, and a potential to reduce medical errors at the point of care [1,2]. Physicians also perceived that quality of patient care and services were enhanced when PDAs were used [3].

Most of the literature focuses on the benefits of EKRs on a PDA [4,5]. However, the use of electronic knowledge resources can also lead to tensions, especially in residency training. Tensions may arise between the resident (with the use of a PDA) and the supervisor, or between doctor and patient, with respect to the use of a PDA in the examination room [3,6–8]. Other types of tension could be (for instance) frustration with irrelevant information, or disagreement between the EKR and hospital guidelines. These can be classified into three types: (T1) user–computer tension, (T2) social tension, and (T3) organizational tension. An example of a scenario illustrating T1 tension is as follows: a resident is looking for a topic, the EKR provides information on the topic, but the information is not complete to address the clinical situation. An instance of a T2 tension is as follows: the resident has found relevant information on a topic and discusses with the staff; however, the staff physician disagrees on the basis of his or her intuition, or past clinical experience. A scenario illustrating T3 tension is as follows: while the EKR-based recommendation is valid, it disagrees with hospital protocol, e.g., the number and type of diagnostic tests to confirm the presence of a disease. We examined 26 papers on impacts of information retrieval technology that were retained in our previous literature review [9], and we found that no study systematically assessed T1, T2 and T3 tensions. Of the 26 papers, 7 papers mentioned T1 tensions, 1 paper mentioned a T2 tension, but none mentioned T3 tensions.

While tensions may also occur in non-electronic resources, their frequency of occurrence and how the conflicts may manifest differ. As mentioned previously, EKRs differ from non-electronic resources mainly with respect to ease of access and ability to update with new evidence from clinical

research. This increases opportunity for conflict between supervisors and residents. Also, the dynamic of the conflict can vary, especially as some supervisors rely more heavily on their clinical experience in decision making, while evidence-based medicine places more emphasis on examination of evidence from clinical research [10].

To the best of our knowledge, there has not been a specific investigation into the types of EKR-related tension and their influence on the clinical decision-making process. The usage of information resources is usually associated with (T0) individual pre-search tensions (e.g., perceived lack of knowledge), which are conceptualized as information needs. In present paper, our focus is to highlight the tensions associated with searches for information and the usage of electronic knowledge resources. We did not aim to assess the level of individual tension that led residents to search for information. Based on the type of tension, we will categorize residents' searches for information within EKRs, and interpret consequences of these tensions from clinical scenarios. These consequences will then be used to make recommendations for improving the integration of EKRs on a PDA in health care delivery.

2. BACKGROUND

The pressing need for effective information management drives clinicians to adopt new EKRs to optimize their clinical decision-making. Cognitive processes such as planning, learning and decision making can be thought of as a joint effort between many users and machines [11]. Computer systems do not just improve performance on a particular task, they can also help in the mastery of related tasks. For instance, EKR use may result in an enduring change in the diagnostic or treatment process even in the absence of such a system. Dee and Toelis studied the use of the PDA in five aspects of clinical care, specifically: decision making, diagnosis, treatment, medical test requests, and length of patient stay [5]. Over 50% of respondents in this study remarked that PDA use had changed patient treatment. In addition, even occasional PDA use "can leave physicians with the perception that PDAs influence their clinical decision making and help alter treatment choices in a positive manner" [5]. However, it is also suggested that extensive use of EKRs may induce complacency and dependency, in addition to positive consequences [11].

The negative consequences of EKRs have been considered in previous studies, such as [12–14]. For instance, a qualitative study of the use of EKRs in general practice showed that some challenges included: limited skills in the use of IT products and services, time pressures in primary care and patient reactions [12]. Since EKRs provide up-to-date information, treatment recommendations can change based on results from conflicting clinical trials, which may result in frustration on behalf of the patient, physician or both [13]. Lorenzi and Riley describe a resistance to change, which occurs at the individual

and organizational level. The two are interrelated, i.e., individual resistance can give rise to organizational resistance resulting in a positive feedback loop. Thus, the successful integration of "major information systems into complex health organizations require an effective blend of good technical and good organizational skills" [14] and approaches need to include cognitive, social and organizational issues [15].

This critical review of the literature leads us to propose three types of tensions associated with EKR usage. The T1 tension (user–computer tension) is based on previous work where the inability of residents to find any information or relevant information on certain topics was described [9]. Also, T1 tension could be due to the inability of a resident to accurately process information based on a patient's symptoms [16]. The T2 tension (social tension) was alluded in [6] as well as in [17], p. 156: "Deciding to use new knowledge is a social and political process, which nearly always involves debate and reference to others' views." Thus, the introduction of an EKR can create tension (through debate and disagreement) between the resident and other social actors in the hospital. The T3 tension (organizational tension: constraints associated with organizational routines and health policies) could be between the resident and the health center in which they work. In [18], it is remarked that EKRs may suggest dysfunctional methods, values or prejudices, which may contradict (for instance) hospital routines.

The literature on evaluation of information technology in general, and specifically on the implementation of computerized physician order entry systems (CPOE), support these three types of tensions. First, Yusof et al. reviewed evaluation frameworks for health-related information technology, and suggested domains of evaluation corresponding to the three proposed types [19]: (T1) human–computer interaction, (T2) communication and network relations, and (T3) organization, administration and socio-cultural environment. Second, Aarts et al. and Ash et al. conducted qualitative research studies to examine the implementation of CPOE, and suggest tensions corresponding to the first two proposed types [20,21]: (T1) issues with alerts, and workflow issues; and (T2) interpersonal undesirable unintended consequences, and communication issues. Third, while Westbrook et al. did not mention EKR- related tensions or issues, they examined online EKR-related impacts on physicians using the Critical Incident Technique, which (in contrast) may refer to the first two proposed types [22]: (T1) impacts on individual clinicians, and (T2) indirect impacts on colleagues. Finally, Masters reviewed the literature on factors associated with Internet use and suggested tensions corresponding to the first proposed type [23]: (T1) time, effort, cost, too much information, information confusing, lack of computer skills, and technological difficulties.

3. METHODS

A multiple case study [24] was conducted concurrently with a cohort study of 23 first-year family medicine residents. Cases were defined as critical searches for information, namely searches that have clearly described consequences from a researchers' perspective. A search was comprised of one or several information hits. Information hits (namely an opened InfoRetriever® page) constituted the smallest unit for data collection and analysis. In the recruitment phase, 20 of 23 first-year residents consented to participate. Participants completed a computerized impact assessment questionnaire on information hits they retrieved on a PDA over a 6-month period. Three residents were lost to follow-up before inter- view for medical or pedagogical reasons. Thus, we focused our analysis on information hits generated by 17 first year family medicine residents over 1.5 months. The rationale for this focus on a sub-sample of hits was the building of a workable homogeneous set of qualitative data (similar residents in a similar training context).

The residents were trained to use InfoRetriever® 2003 and 2004 on a PDA, a commercial knowledge resource designed for primary care. The 2004 version provided updated information. For example, new synopses of clinical research, called InfoPOEMs®, and new clinical decision rules were added. This represented a change of less than 5% of the database. There was no change to the user interface. This resource allowed simultaneous searching of seven databases: an electronic textbook (5-Minute Clinical Consult), the database of Patient-Oriented Evidence that Matters (InfoPOEMs), abstracts of Cochrane reviews and guideline summaries, as well as clinical decision and prediction rules, diagnostic test calculators, and history and physical exam calculators. With consent, we used the InfoRetriever® tracking function to identify and record each information hit in a log file on the participants' PDA. The InfoRetriever® tracking function did not track keyword searches that contained no hits. This occurred, for example when a search did not produce any results, or when retrieved information was not applicable to the reason for the search. Log files provided specific data on information hits viewed by the resident, with each hit defined by a title and unique identification number, when the information was opened (date and time stamp), and what search strategy was employed. To reduce recall bias, our impact assessment questionnaire was presented using a method inspired by computerized ecological momentary assessment. Residents answered a computerized questionnaire on PDA after they searched InfoRetriever®. The questionnaire popped up daily, to remind residents to complete unanswered questionnaires. Most questionnaires (79.5%) were answered within 3 days of the information searches. Questionnaire responses were added to an InfoRetriever® usage log file on each PDA, and transferred to a research server via the Internet.

One co-author (RG) recruited participants from two McGill family medicine teaching units in fall 2003 (group 1) and winter 2004 (group 2). Participants received three hours of training in two sessions,

one of which was devoted to using InfoRetriever®. The second training session was delivered at the start of a 2-month family medicine block rotation during which participants attended an Evidence Based Medicine course. Further InfoRetriever® training was offered weekly during the 2-month course. Thus, participants received InfoRetriever® training in a reiterative fashion [25]. Ethics approval was obtained from the McGill University Institutional Review Board.

The quantitative data collection (cohort study) guided the qualitative data collection (multiple case study). Qualitative data consisted of observations, log-reports, archives and interviews. Thus, multiple sources of evidence allowed us to critically examine interviews, notably the coherence between interviews and the textual content of corresponding hits. In addition, qualitative data permitted us to identify searches for information from a series of hits. One of the authors (PP) interviewed all participants. PP, with experience in family medicine and qualitative research, was unknown to the participants. Interviews varied in duration from 15 to 120min, and retrospectively scrutinized the context of InfoRetriever® usage, as well as searches for information (interview guide available on request). Residents were inter- viewed once, on searches they performed over a period of 1.5 months (on average 47.2 days). To stimulate memory of earlier events, log-reports on InfoRetriever® usage and questionnaire responses were reviewed with residents. Log-reports guided interview as follows: (1) InfoRetriever® usage log files with self-reported impact were saved as text files (e.g., participant 17 log-report.txt), and the textual content of information hits was archived in text files (e.g., participant 17 hit 235.txt); (2) prior to each interview, these text files were analyzed by the interviewer, and information hits opened during the same hour of the same day were assembled into potential searches; (3) during interviews, potential searches were reviewed and usually confirmed by interviewees; (4) post interview, extracts of interviews and text files (information hits and corresponding impact) were systematically assigned to each search using NVivo2 software for qualitative data analysis. Interviews were audio taped, and transcripts were analyzed by the authors according to the critical incident technique and a three-step thematic analysis.

Reasons why participants searched databases were extracted from interviews on critical incidents that revealed trustworthy factual stories (qualitative evidence). Critical searches were identified using the critical incident technique that provides detailed empirical illustrations of important events [26]. A critical incident is a clear event from the observers' perspective, and has clear consequences. In line with this definition, a critical search (a case) is a clear event from the researchers' perspective, notably a clear answer to the following five screening questions:

1. Why did you do this search?
2. Did you do this search by yourself or in the presence of someone else?

3. Do you remember where you were when you did this search?
4. Did you do this search at the moment you needed the information or at a later time?
5. Did you search in another source of information?

And clear consequences, notably a clear answer to two questions:

1. If this search provided recommendations, can you tell me what were they and did you apply them?
2. Did this search permit you to improve your practice?

Two researchers (NM and JL) classified interviews as corresponding to T1, T2 and/or T3 types of tension. Tension-related extracts were first identified by looking for resident-InfoRetriever® interactions (case revealing T1 tension), or for any disagreement in the decision-making process between the resident and medical staff, nurses or patient (case revealing T2 tension). Finally, T3 tension-related extracts were identified by looking for the context, where the resident agreed with the recommendation but could not carry it through due to organizational routines (case revealing T3 tension). Given that interviews were in French or English, a French-English lexical-semantic tool, Sémato, was used to complement this qualitative content thematic analysis. A theme-related lexicon was defined for each of three tensions using Sémato. The program subsequently assigned extracts of interview transcripts to themes T1, T2 and T3 based on the occurrence of tension-related lexical chains of characters and semantic forms (meta-thesaurus built by the University of Quebec in Montreal, UQAM). The validation step for the qualitative con- tent thematic analysis was performed by one of the authors (PP), and disagreements in assignments of tension-related interview extracts to themes T1, T2 and T3 were resolved by another author (RG).

4. RESULTS

We documented 1981 information hits generated by 17 first year family medicine residents during a 1.5-month period. The three most used databases were guideline summaries, an electronic textbook (5-Minute Clinical Consult), and InfoPOEMs. From these hits and the results of the interview, 314 critical searches or cases were identified. Since, we were restricting our attention to cases within a resident-patient decision- making scenario, we considered 84 cases for further analysis (16 residents). Fig. 1 illustrates the flow of information used in the subsequent analysis.

Thirty-six of the 84 cases were identified by NM and JL as having tension (Sémato, the lexical analysis tool con- firmed 13 of 36 cases and missed cases where a tension was evident based on the context, but unclear in lexical-semantic structures). Twenty-three cases were validated by PP, and in 6

of the remaining 13 cases, consensus was reached (1 case of the 6 possessed a form of tension). The remaining seven cases were resolved using RG as an arbiter (1 case of the 7 possessed a form of tension). Thus, 25 of 84 (29.8%) searches within a resident-patient decision- making scenario were linked to tensions. A summary of the process and outcome of the arbitration is shown in Fig. 2.

Sixteen cases were classified as a T1 type of tension, seven cases as T2 tension and three cases as T3 tension. Types of tension are not mutually exclusive, for instance, one case was classified as having T1 and T2 tension. Table 1 presents the 16 cases of T1 tension. A common consequence that is evident through these cases is that InfoRetriever®-related tension is a source of frustration, either due to lack of information on the topic or insufficient information for clinical decision making.

Table 2 presents seven cases of T2 tension. Unlike a scenario, which involves tension between the resident and InfoRetriever® (T1), the interaction between a resident and other social actors at the hospital can be more complex. Many new aspects come into play for the T2 type of tension:

(a) Willingness of the supervisor to be challenged.
(b) The attitude of the supervisor in accepting that he/she may be wrong and to agree with EKR recommendations.
(c) The impact of patients, colleagues (e.g. other medical students, residents).

Some of these aspects are a result of power issues playing a role in the relationship between a resident and supervisor, which is further compounded by the presence of a new element, the EKR.

Table 3 presents three cases where the information from the EKR is relevant but nonetheless conflicts with hospital routines. For example, P2S10 illustrates that although recommendations are suggested by the EKR (e.g., performing a CT scan), they may not be feasible to implement.

5. DISCUSSION

EKR-related tensions are common, since residents experienced user–computer or social or organizational EKR-related tensions in about one third of searches for information using InfoRetriever on PDA within a clinical decision-making con- text (T1 or T2 or T3 tensions found in 25 of 84 cases, i.e., 29.8%). To our knowledge, the present study constitutes the first systematic examination of tensions associated with the routine usage of electronic knowledge resources. Only 5 of the 25 cases of tension were observed in association with information derived from an electronic textbook (5MCC), while the other 20 cases were observed in association with synopses, such as InfoPOEMs, or abstracts of Cochrane reviews. This is in agreement with our premise, as up-to-date resources tend not to be as complete as

textbooks, present new knowledge that may be contradictory or unknown to the supervisor or suggest methods which are more current than hospital procedures.

An illustration of the first type of tension arises when a resident fails to find information on a particular topic (T1). In such cases, InfoRetriever® can be a source of frustration, either due to a total absence of information on the topic or insufficient information for clinical decision making:

"... I found some information [on hyperthyroidism], but it's information that I already know. I didn't get any information that I did not know. ... Did I find information in InfoRetriever? Not really."

The presence of an EKR on the PDA can potentially change the dynamics between the resident and other social actors at the hospital (T2). Most of the cases that illustrated a T2 tension involved tension between the resident and the supervisor. In this situation, power issues between the resident and the supervisor can result in significant tension, which include: willingness of the supervisor to be challenged, attitude of the supervisor in accepting that he/she may be wrong and willingness to agree to recommendations provided by the EKR.

It should be emphasized that although InfoRetriever® provides recommendations for treatment, this information is one of several factors considered in the clinical decision-making process. For instance, in the following quote, the resident disagreed with the recommendation and instead opted for a conservative treatment preferred by the patient:

"I knew the patient had this [disease: (De Quervain's tenosynovitis], and I just wanted to know, like I knew there were different treatments [. . .] and I wanted to know what was the bottom line for treatment. [I did this search] with the patient. . . . It just said that the only treatment that is proven to work is corticosteroid injection. . . . [. . .] I talked with the patient. I showed her, but she didn't want an injection."

The third type of tension results from a disagreement between an EKR recommendation and hospital policy (T3). In this scenario, the recommendation for patient care, but is superseded by hospital policy.

"It [InfoRetriever] said do a CT scan [for diagnosis of mastoiditis], and the other one said no. The other one didn't say to do it necessarily. . . . It was a Friday, and we said we'll try the antibiotics

until Monday and then if we need a CT scan, we'll do it Monday."

Although most tension-related cases illustrated a single type of tension, the tension categories are not mutually exclusive. For instance, in the following, two types of tension coexist in a clinical decision-making context:

"They [searches] provided recommendations that non- steroidal anti-inflammatory drugs were helpful, but it was only in post-op patients and it was somewhat reassuring, but it wasn't completely generalizable . . . Because the staff in the emergency thought that using non-steroidal anti- inflammatory drugs in the elderly was contraindicated, and I wanted to prove them wrong. But unfortunately, I couldn't because it wasn't the exact population I needed."

In the above case, the resident found some information on the topic of interest but did not find information necessary for the current patient, resulting in frustration (T1). While the information in InfoRetriever® was sufficient to challenge the standard of treatment, it was not enough to convince the staff and change the clinical decision (T2). A notable mention is that information derived from InfoRetriever® may also reduce decisional conflict, for instance, the applicability of certain medications to the treatment of disease:

"I put the patient [who was hypertensive and depressed] on beta blockers . . . but then I asked myself, what if beta blockers made her depression worse? . . . I did the InfoRetriever search and I decided to keep her on the beta blocker."

Our sample of cases was limited to situations which arise during family medicine residency training and involved a small number of residents. Analyzing the experiences of family physicians in non-teaching settings may reveal a different distribution in the type of tensions. While the frequency of T3 or organizational tensions may be the same, among physicians' with greater clinical experience, the occurrence of frustration due to lack of information (T1) may be less. Although instances of conflict due to power issues may be less frequent for a staff physician (T2), disagreements between EKR recommendations and patients would still occur. In addition, we considered cases within a resident-patient decision-making scenario; however, tensions outside of this context could occur, for instance if the resident wished to expand his/her knowledge base, but the relevant information was not available (T1). Finally, we did not study cases where a search was conducted and no information was found (could

not be tracked by InfoRetriever®), which could lead to frustration (a T1 tension). We also did not study cases where the search topic was found, but the InfoRetriever®-information was not applicable, which could have resulted in no tension, T1, T2 or T3 tension. As these cases were not considered in our analysis, we may have underestimated the frequency of EKR-related tensions.

6. CONCLUSION

Electronic knowledge resources provide an invaluable tool for the process of clinical decision making. This is especially true for residents, who can use EKRs as a quick and easy source of research-based information to confirm their clinical knowledge in support of their practice. However, the use of EKRs can also introduce different forms of tension. Our work suggests that tension can be classified as user–computer tension, social tension, and tensions due to constraints associated with health organizations/systems. These tensions can be interrelated and are not mutually exclusive.

Since the use of EKRs is likely to increase, steps should be taken to address these types of tension. For instance, to reduce T1 tension, EKRs can be made more current by automated updating via wireless connection to the Internet. The T2 tension should decrease with time as senior physicians will become more accepting of EKR use by residents. Since the development of research results proceeds faster than hospital policy can be modified to accommodate them, T3 tension will always be present.

SUMMARY POINTS

What was known prior to this research?

- Electronic knowledge resource (EKR) use can enhance clinical decision-making with respect to the diagnostic or treatment process.

- Diagnostic information and treatment recommendations could change based on results from conflicting clinical trials, which may result in frustration on behalf of the patient, physician or both.

- Prior literature has suggested that there may be tensions associated with the use of electronic knowledge resources; however, no study systematically assesses tensions associated with EKR usage in residency training.

How this research adds to our understanding?

- EKR-related tensions are common. In our study, family medicine residents experienced tensions in about third of searches for information using InfoRetriever® on handheld computers within a

clinical decision- making context.

- EKR-related tensions can be classified as (T1) user–computer tension, (T2) social tension, and (T3) organizational tension.

- Most of the cases that illustrated a T2 tension involved tension between the resident and the supervisor. This can be due to power issues, such as, willingness of the supervisor to be challenged, attitude of the supervisor in accepting that he/she may be wrong and willingness to agree to recommendations provided by the EKR.

- Tension categories are not mutually exclusive and can coexist in a clinical decision-making context.

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TABLES AND FIGURES

Table 1 – Extract of interview illustrating a T1 tension in resident-patient decision-making scenarios.

Cases	Extract of interview
P2S1	"I had a patient [. . .] with ruptured membranes and she was Gram positive [. . .] and also she was not in labour, so I wanted to know if we should induce delivery or something. But I didn't get an answer (laugh)."
P2S4	"My friend's mother had headaches and vision problems and all that. So I went to see what they [InfoRetriever] were saying concerning temporal arteritis. My answer wasn't. . . It wasn't complete in InfoRetriever."
P2S7	"I had a patient who was supposed to come so we could discuss vasectomy. And I think he was only 26 years old or something and he already had three children. It was before I saw him. I knew his wife had problems with the pill but she didn't try a diaphragm. And I wanted to inform him about this option [. . .] because he is still young. It [information found in InfoRetriever] was not exactly what I was looking for [. . .]"
P3S15	"It was. . . for Mallory-Weiss, it was. . . it [InfoRetriever] only presented the information for a patient who isn't stable and what to do [. . .] My patient was stable."
P4S17	"Even with that information, I wasn't able to make a decision."
P5S2	"I saw a patient in emergency, who had cellulitis . . . I said I'd look up [antibiotics] . . . It wasn't much help. There's actually very little on that [infection]. So it didn't really provide any recommendations."
P9S1	"Well InfoRetriever didn't give me anything [a time issue regarding a pregnant patient – pregnancy wheel], so it didn't conflict or agree."
P9S2	"Like I said it didn't have the distribution of the lesions which is important for derm. And it didn't have I think the natural history or something to that effect."
P9S7	An information hit was retrieved to answer a question concerning temporo-mandibular joint syndrome. ". . . it didn't. . . strictly speaking explained what I was looking for."
P16S9	"The only thing is that in 5MCC [InfoRetriever], they say that the pain related to Osgood-Schlatter can come back for about 50% of people, which I didn't find anywhere else. [. . .] I talked about that with a specialist, and I asked her, and she said that in fact it's probably an error in the 5MCC, but she said no, it doesn't come back.

The only nuance that she added was that yes, people can have pain, but in adults, it won't be called Osgood-Schlatter, we will call it anterior tibial tendonitis."

P19S8   "They [searches] provided recommendations that non-steroidal anti-inflammatory drugs were helpful, but it was only in post-op patients and it was somewhat reassuring, but it wasn't completely generalizable . . . the staff in the emergency thought that using non-steroidal anti-inflammatory drugs in the elderly was contraindicated, and I wanted to prove them wrong. But unfortunately, I couldn't because it wasn't the exact population I needed."

P18S1   "Because I had a patient who had a migraine, and I had read something in a journal about Vitamin B, riboflavin and I wanted to recall what I had read. It's just that riboflavin can help in the prevention of migraine but it doesn't say that all patients should be put on that."

P20S1   ". . . what happened was that the patient was already on iron treatment, I wanted to know exactly how long they needed. I couldn't find an answer from InfoRetriever . . ."

P20S4   "I saw a patient who had a knee injury . . . I wanted to search for treatment, but I don't remember getting anything out of it [. . .] I was searching for the name of the exam that I did, but I didn't find it [. . .] it was a situation where there was a time constraint, and I thought I was wasting time reading those things."

P20S6   ". . .I found some information [on hyperthyroidism], but it's information that I already know. I didn't get any information that I did not know. . . . Did I find information in InfoRetriever? Not really."

P23S11   "It was a patient of mine who is 72 years old and has claudication in both legs [. . .] I was wondering if there was something that we could do medically . . . I didn't feel confident with what I read in InfoRetriever and I wanted to get more information elsewhere."

Table 2 – Extract of interview illustrating a T2 tension in resident-patient decision-making scenarios.

Cases	Extract of interview
P2S8	"I knew the patient had this [disease (De Quervain's tenosynovitis], and I just wanted to know, like I knew there were different treatments [. . .] and I wanted to know what was the bottom line for the treatment. [I did this search] with the patient. . . . It just said that the only treatment that is proven to work is cortico-steroid injections. . . . No [I didn't agree with the recommendations]. I would have tried a more conservative treatment because I think that it can work in 10% of the times [. . .] I talked with the patient. I showed her, but she didn't want to [receive injections].
P2S15	"There was a patient who came into the emergency [. . .] who had a headache for the past month [. . .], migraine headache. And I wanted to know what the treatments were. [InfoRetriever recommended the drug triptan]. I showed it [recommendations] to the staff, like what do you think of this? And they said no, no, no, we don't do that stuff."
P3S9	"It was a restless patient with Parkinson's . . . The nurses wanted me to give Haldol but I used the recommendations." [from InfoRetriever, and prescribed Risperidone]
P4S2	"So I knew he needed an (x-ray) [for a twisted knee], but actually, it just so happened that a staff said no . . . Ottawa Knee Rules say yes. It's like he hadn't heard of that, so I said ok, then he saw it and he agreed."
P16S3	"We were at the emergency [my supervisor, another resident and I], and it was a patient coming in with herpes . . . zoster, and we started to discuss the treatment possibilities. The supervisor wanted to show us that he could find the information on the internet, and I wanted to show him I could find the same information in 30 seconds versus half an hour that it took him to finally open POEMs on the web, so the same information [. . .] And then he [supervisor] never wanted to admit that it was a good idea to have the machine [InfoRetriever on the PDA] with us (laugh), that it was much quicker."
P19S8	"Because the staff in the emergency room thought that using non-steroidal anti-inflammatories in the (aged) was contra-indicated, and I wanted to prove them wrong. But unfortunately, I couldn't because it wasn't the exact population I needed."
P20S3	"I wanted to try antidepressants . . . I went to InfoRetriever [for treatment of irritable bowel syndrome], and the staff didn't think that it was going to help, and I went to the InfoRetriever, I found the information, and talked to him about it . . . I found out that

antidepressant was found in a trial that it was working . . . and then eventually I ended up discussing with the patient about antidepressants."

Table 3 – Extract of interview illustrating a T3 tension in resident-patient decision-making scenarios.

Cases	Disagreement detail
P1S2	"It said we could use a medical treatment [for a pregnant patient wanting a first trimester abortion], I think it was Methotrexate, but that sometimes we still had to use a dilatation and curettage if it didn't work well [. . .]Methotrexate wasn't offered in the hospital so it wasn't really an option for the patient."
P2S10	"It [InfoRetriever] said do a CT scan [for diagnosis of mastoiditis], and the other one [a book] said no. The other one [a book] didn't say to do it necessarily. . . . It was a Friday, and we said we'll try the antibiotics until Monday and then if we need a CT scan, we'll do it Monday."
P3S12	"In InfoRetriever, if we have a positive antibody [for hepatitis serology], that's it. Here, we need to do an additional test and send it to the government lab."

Fig. 1 – Flow diagram illustrating the flow of data used in the tension analysis.

| 1981 Information hits generated by 17 first year residents in similar training context |

5 Screening Qs + 2 consequence Qs

No

Not considered for further analysis

Yes

314 Critical searches or cases

Is case part of a RPDM scenario?

No

Not considered for further analysis

Yes

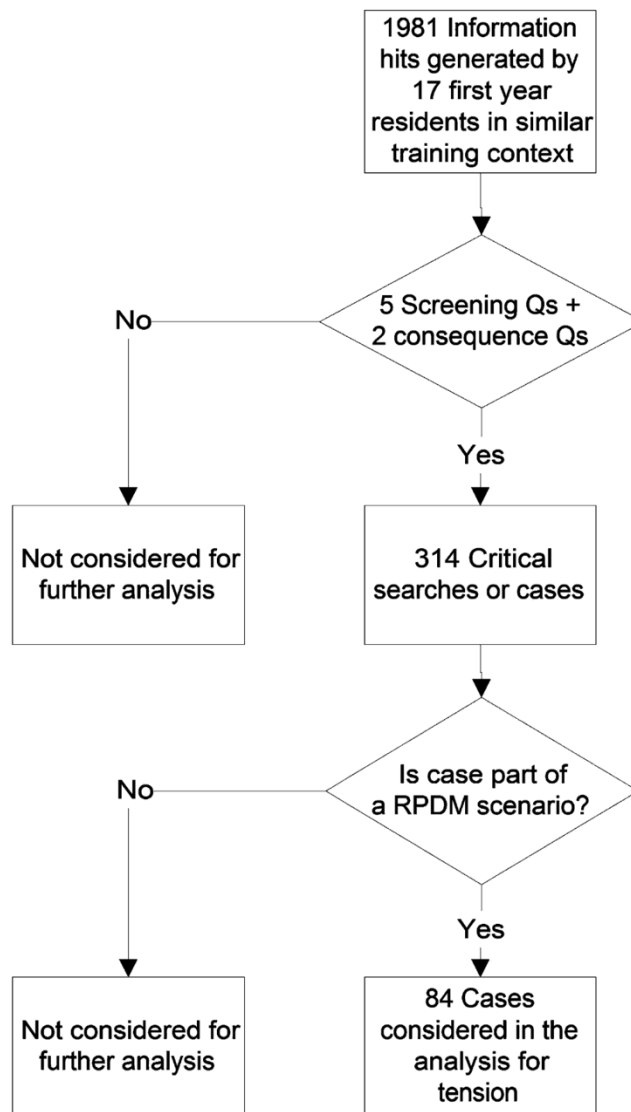84 Cases considered in the analysis for tension

Fig. 2 – Flow diagram illustrating the process and outcome of validation and arbitration to identify cases possessing a form of tension.