Developing a Framework for Evaluation of Technology Use at Multidisciplinary Meetings in Healthcare

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Abstract

Identifying an appropriate method to evaluate the use of technology during patient case discussions at multidisciplinary medical team (MDT) meetings, is problematic. A number of approaches conducted over an extended period of study are described and the lessons learned are explained. A framework is proposed to serve as a basis for evaluation of technology use in these complex collaborative work settings that incorporates hospital, technology and people perspectives.

1. Introduction

Designing and evaluating technology for use in healthcare is recognised as a particular challenge because simulation of real clinical situations is difficult in practice. Firstly healthcare work requires expert knowledge, and exchanges among groups of clinicians are often not very understandable to a non-medical observer. Furthermore it is important not to obstruct on-going work that might increase risks for patients, and video recording can be problematic because of the confidential nature of the work, and the need to maintain research data confidential and secure [2].

Multidisciplinary medical team (MDT) meetings (MDTMs) have become routine activities in hospital work, particularly for cancer patient management in the Western world. MDTs tend to be constructed around cognate disease processes, such as urological disorders, or lymphomas. The level of specialisation of the MDT is likely to depend on the size of the hospital and the range of services provided. A typical MDT consists of physicians, surgeons, radiation and medical oncologists, radiologists, pathologists, nursing and support staff, and allied health professionals appropriate to the MDT.

Before MDTs come together in a meeting, an agenda is circulated and team members independently prepare for the meeting by reviewing any information they may have on each of the patients on the list. At an MDTM there are two main tasks undertaken, as follows. i) The tests results available are discussed, correlated and a diagnosis and stage of disease is agreed by consensus. For many diseases, especially cancer, the clinical findings are correlated with the radiology and pathology results to provide the information necessary for diagnosis. This ‘triple approach’ to diagnosis reduces the false negative and false positive rates of the individual investigative procedures and improves the sensitivity and specificity of the diagnostic process, overall. ii) In the second part of a patient case discussion, a management plan is agreed based on current clinical practice guidelines for the status agreed in the first part of the discussion. The main inputs for this group task are the diagnosis just agreed in (i), and the patient’s performance status (or level of fitness). The MDT refer to research and best practice guidelines to direct their decision-making, and a record is made of the decision. Having all of the specialities who are involved in a patient’s treatment present together to discuss and agree a management plan makes co-ordination more efficient between specialisms and we believe that patients will ultimately benefit from the process. The record of the MDT discussion will be available in the patient’s electronic record and it directs further work with the patient.

The MDT meeting may be the only time that the multidisciplinary team members get the chance to meet during the week, because they otherwise work independently within their speciality, and typically they have busy schedules. This opportunity to meet, and have a coffee together, is a valuable opportunity for members to have informal exchanges and likely plays an important team-building and development function. The educational role of the meeting is acknowledged by professional organisations; and Continuing Medical Education (CME) credits are awarded for recorded attendance. The forum serves important organisational functions: it is useful for gathering audit data, and satisfies quality assurance and regulatory requirements.

When designing a method of evaluation for an MDTM, its purpose or function needs to be taken into account. Eval-
valuating the technology alone, as per technical specifications, is not enough. Designing an evaluation of the use of the technology at an MDTM will not be fully satisfactory unless the educational and organisational needs as well as the patient management and socio-emotional role of the discussions are incorporated into the evaluation, since the identification of ‘outputs’ from the MDT activities depends on recognising the purpose of the activity in the first instance.

Stress and cognitive overload among team members need also to be considered. While stress is acknowledged as a factor influencing the use of technology in industries such as aerospace and automotive industries, it is only relatively recently acknowledged in healthcare [10, 14, 1].

It is in the context of the acknowledged problems identified in literature that we examined our data to help us identify factors influencing the use of technology at MDT meetings, and to propose a framework for its evaluation. When evaluating the use of technology in the MDT setting, account needs to be taken of the different dimensions that impact on its use. The review of our results will demonstrate the need for such a framework in the analysis of such a work system. We started by utilising McGrath’s framework of People-Process-Technology [11] and adapted it for use in this MDT setting. Our framework is represented in Figure 1 and has the following dimensions. The Technology Dimension incorporates technological tools as well as specifications for the computer hardware, software and standards such as DiCom, HL7, SNOMED, etc. The Organisational dimension concerns staff contracts, policies, procedures, the physical infrastructure and economic considerations. Concern about physical space has been identified as an important consideration in the design and use of technology in MDT meeting settings [9]. The third dimension is the MDT and includes all the staff, their knowledge, needs activities and constraints as outlined above. These dimensions are set against a social background. The intersections of these dimensions with society include patients, family, carers and others who are affected by the MDT system.

In the intersection between Organisation and MDT we identify role, scheduling and the constitution of the MDT as central issues. Roles that should be incorporated into MDT is a topic of concern [15], as well as how MDT members interact, and the group dynamics exhibited [8]. Scheduling and timing have also been identified as a challenge in making effective MDTs [6]. High levels of co-ordination are needed for information communication and sharing, with the Time constraints under which people work in order for the work processed to be efficient. Time is also reported as one of the key dimensions to be taken into account in medical work [3, 13, 12], and an evaluation of the work system MDT needs to take account of time constraints and the pressures that the team members may be working under.

In the overlap between the MDT and Technology we place specific tools that might be used by particular roles at the MDT meeting, and usability of these tools. We represent the infrastructure, including networks and imaging standards, as factors that impact on usability of and performance in the overall system, and we point out that these technologies are embedded in the organisational system (including physical space). The overlaps between Organisation and Technology prompts the examination of organisation structures and virtual service structures. In modern healthcare systems these organisations need not mirror each other. Indeed in many cases nowadays technology enables health services to span several organisations/ legal entities.

Meeting Outcomes: At the heart of the ‘MDT system’ is the service to patients. While it is generally believed that patients experience a benefit from having their case discussed among a team of specialists at an MDT meeting, there is little concrete demonstration of any benefit [15]. We can anticipate that current drives to identify benefits for patients will also look towards the technology, people and organisation that contribute to the benefit. When evaluating technology use in the MDT setting we must ensure that the technology contributes, or facilitates, an overall benefit to the patient. Developing technological tools, such as increased support for interaction, and decision-support tools, that are usable within the specialised group setting has the potential to directly impact on the well-being of patients.

2. Methodology

This study is part of a long-term ethnographic study of MDT working and MDTMs in a large teaching hospital. Surveys and interviews were undertaken to verify observations and investigate particular research questions in depth. The data used in this paper are derived from questionnaires...
Conducted in 2004, 2005, and 2006; video-recordings taken in 2006, and 2012, and over 50 interviews conducted with team members over the period 2005 to 2012.

Dataset 1: A set of 110 participant evaluation surveys were gathered over 7 MDTMs between early 2005 and late 2006. Two of these MDTMs were fully co-located while 5 included discussion with two remote hospitals in videoconference. These surveys were designed to provide an overall evaluation of the MDTM from the participant’s perspective. MDT members were asked to judge the contribution of the clinical presentation of the case, and the pathology and radiology contributions as to whether they were ‘too little’, ‘too much’ or ‘about right’. They were also asked to indicate if they felt that the time spent in discussion on patient management was ‘too long’, ‘too short’ or ‘about right’. They were also asked to indicate if they felt that the time spent in discussion on patient management was ‘too long’, ‘too short’ or ‘about right’.

Dataset 2: A separate set of assessments (on an 11-point scale) from observer participants were taken over six of the meetings in Dataset 1. The observer participants were asked to rate the educational value of each case discussion, which was either co-located or conducted in videoconference.

Dataset 3: Observations that add qualitative data to the quantitative results reported are provided as a means of validating the results for the respective datasets. MDT meetings have been observed on an on-going basis for almost 10 years with up to 8 MDTs.

Dataset 4: Over 50 interviews have been conducted with both vocal and non-vocal MDT participants. Approximately 30 interviews of up to one hour have been undertaken with senior clinical staff, MDT leaders and other participants. They covered a range of topics related to MDT meetings, and proved very useful in validating observations and helping to interpret findings. Of the questions asked, and reported here for illustration of the complexity of evaluation of the MDT meeting, refers to the participant’s experience of the MDTMs and their satisfaction with them.

Dataset 5: A survey was undertaken between 2009 and 2011 enquiring of levels of satisfaction with aspects of the MDT meeting, and the use of technology in particular.

Dataset 6: A set of data that examined speech interaction in videoconference at MDTM are revisited.

2.1. Findings

Evaluating the overall meeting (Dataset 1): Typically respondents marked off ‘about right’ in most questions with respect to the contribution made from the clinical, pathology and radiology specialists. It was their overall evaluation of the meeting that revealed differences. A summary of results of this survey are given in Table 1. For some meetings there was considerable variation in the ratings given. For meeting 7, for example, some members rated the meeting as low as 9, while others gave it the very high score of 2. There tended to be more variation in scores for the meetings held in videoconference, but since there were only two meetings that were fully co-located, it is difficult to establish with certainty from these data whether meetings in videoconference have the potential to be more satisfactory. When asked at interview about factors that contribute to a successful meeting, respondents typically report that having all the team members present, all the data available, and time to discuss the case ‘properly’ are key to a successful meeting. Radiologists and pathologists typically added that the success of an MDTM is also dependent on having the agenda circulated in time for them to conduct a full review of each patient’s materials, as well as the necessary information - whether it is radiological imaging, or biopsy / tissue samples. It is not unusual for a patient to have tests conducted at a referring hospital, and these need to be located and sent to the specialists for review prior to the MDTM.

Evaluating Individual Case Discussions (Dataset 2): The variation in ratings given for co-located and videoconference MDT meetings is further evident in the educational ratings given for individual patient case discussions held in co-located meetings or for those held in videoconference.

Table 1. Evaluation of Meeting - Overall

<table>
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<th>Meeting</th>
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<th>Low</th>
<th>Mean</th>
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</table>

* CL = Co-located; VM = Video-mediated

Figure 2. Educational Value of Discussion

Figure 2 shows that co-located discussions tend to rate more mediocre than those held in videoconference, which were rated highly, or rated very poorly. Talking to participants afterwards, MDT members described some case discussions as being ‘very interesting, complex cases’ and said that it is often easier to hear participants during videoconference discussions, since participants tend to speak louder, and remote contributions are broadcast via speakers.
Data from observation and interviews suggest that there is something very satisfying about co-located discussions, although it can be difficult to hear people who speak in low voices. In videoconference, by comparison, the audio is potentially very clear but is dependent on the suitable placement of microphones. Sometimes the vocal participant is not sitting near a microphone. This is likely to be in the large meeting room and is more frustrating for remote participants in videoconference than for co-located colleagues.

### Table 2. MDTM participants' comments

**Patient Information**
- 'I would like more relevant information . . . succinctly presented'
- 'Because I'm trying to read, talk and record it is difficult . . . but the nurses notes are better for me.'

**Organisation and Work Process**
- 'the biggest problem is the increasing number of patients being discussed at each meeting'
- 'I would have liked more information prior to meeting'
- 'First cases in meeting tend to be discussed for longer - meaning there is a rush to get through the final cases'
- 'too much said - considering the limited time available'
- 'sometimes too much time on earlier cases'
- 'reduce cases, or increase talking speed'
- 'need summary [of management discussion]'
- 'noted external radiology not on system'
- 'need more structure - Age - Performance Status - Investigations'
- 'plans for future care is sometimes unclear . . . '
- 'no need to discuss some benign cases'
- 'I’d like to know if M was present [when I look back at record]'
- 'legal issues when we agree to disagree with written report'
- 'too little time to properly discuss'

**People**
- 'what is the name of the [role]'
- 'We have to have the radiologists there'
- 'its much better now that we have more oncologists'
- 'We really need one of the Roles to be present'
- 'Y's leadership missed'
- 'everybody is rushing to other activities'

**Technology**
- 'I hate it when the computer crashes'
- 'access to EPR would be good'
- 'would like more detail e.g. photos'
- 'I dislike lags and poor quality video'
- 'its difficult to hear at times'
- 'very difficult to hear X - missed some discussion'
- 'air-conditioning is noisy'

Several issues were consistently raised throughout the Datasets that impact on the evaluation of these MDT meetings. In addition to providing ratings on the 11-point scale, many respondents provided comments explaining their selection. Comments were only offered in cases where ‘about right’ was not selected, and included statements such as ‘the biggest problem is the increasing number of patients being discussed at each meeting’. These issues were verified in observation, and frequently raised in interviews. The issues persist and were raised again in the most recent survey. A selection of representative comments is given in Table 2.

The problems in sharing radiological images and pathological samples relate to variation in standards used in radiology between centres. These variations are not only technical and procedural as reported in [5]. Issues of contractual arrangements have arisen that also have an impact on sharing. For example, when a patient has a PET scan and is then treated with either chemotherapy or radiation therapy, the next step is usually to evaluate the effectiveness of the treatment with a follow-up PET scan. The pre-treatment scan is compared with the post-treatment scan to evaluate the impact of the treatment and any change in the abnormality. However variations in equipment, settings used and institutional protocols mean that it is best to compare scans performed under the same conditions, i.e. using the same scanner with the same settings. This is not always possible, because of a clinician’s access to PET scan facilities, for example, and it can make it difficult for a radiologist to provide a high quality assessment of the current abnormality. Typically, clinicians can be contracted by one hospital, but are an integral part of the MDT at another hospital. The clinician’s contract may obligate the individual to arrange investigative procedures (radiology or pathology) at a particular institution because of procurement contracts, even though the MDT are aware of differences in the standards used between both institutions. These difficulties can lead to frustration for the MDT.

### Table 3. Views on the usefulness of MDTMs

- "I greatly value the advice I get from my colleagues. I probably change or modify the treatment plan I had in mind . . . maybe in 5 - 10% of cases"
- "The function of a proper MDT and role of chair is to avoid unnecessary repeat discussions"
- "discussion provides a good summary of the case and gives a better insight into how others arrived at their conclusions - and the factors being considered in the ‘grey areas’"
- "I worry about technical issues such as sound quality"
- "regular attendees can appreciate subtleties that may not be appreciated by a reporting [specialist]"
- "Direct verbal interaction with the relevant specialities is essential"
- "I don’t like if one of my cases is discussed and I’m not there"
- "… digital images . . . ’ don’t fully understand them and we can’t really see the detail I’d like to see sometimes . . . ."
- "we have to be able to see the images"
- "… videoconference doesn’t replace the benefits of being in the same room, but its a very useful practical alternative"
- "if the meeting is properly run and videoconferencing facilities reliable, then there is no need to be in the same room"
- "Subtlety is lost in teleconference and . . . there is less discussion"
- "videoconference is ok - but misses out on all the non-verbal communication inherent in face-to-face meetings"

Differences in contractual obligations may not only determine access to diagnostic facilities, but can have an impact on how the MDT members communicate. As one member put it “it would make things a lot easier if I was contracted by the same employer as the rest of the MDT. I’d like that - I’d feel more part of the team.”

**Dataset 4:** When MDT members are asked of their ex-
perience of MDTMs, there is frequently a mixed response, even though all were in agreement that there is some benefit from meeting. Individuals articulated the benefits of meetings in a range of ways, and some of the comments are given in Table 3. The diverse views expressed in interview reflects the difficulty of evaluating the application of technology in these settings. One respondent summed up by citing an old nursery rhyme: “when they are good they are very very good, but when they are bad ... they are horrid!”.  

Dataset 5: Responses to questions that asked about the level of satisfaction with the technology, members’ ability to hear the proceedings and their interest in being able to see remote participants more clearly are given in Table 3. The most surprising finding is the fact that many people cannot hear the proceedings properly, and that participants rarely make this known during a meeting. Sometimes a senior member of the MDT may remark to a junior team member that s/he cannot be heard and request that s/he speak more loudly. However, some senior staff revealed in interview that they felt that perhaps they were the only one with a hearing deficit and were reluctant to reveal that deficiency. It has never been observed that a junior member of the MDT asked a senior member for clarification, or to repeat something that the more senior colleague has said.

There is relatively little interest expressed in being able to see remote participants more clearly. However, from our earlier study reported in [4] we demonstrated that the team has a requirement to view their remote colleagues, and we believe that this expressed ambivalence to see remote team members is understating their real needs. Analysis of screen recordings shows that team members choose to see their colleagues across the video link for 60% of the time during a patient case discussion. The rest of the time is used to look at patient radiological images (22%), pathology slides (4%) or a text summary of the clinical findings (13%) [4].

Although over 70% feel that the technology is satisfactory, those who disagree with the statement tend to be active participants, and include 31% of pathologists, 2% radiologists, 15% surgeons and 15% physician respondents. Remote participants tended to rate the technology as less satisfactory than those at the large hospital.

Dataset 6: One of the targeted data gathering exercises we conducted was an analysis of a set of recordings of cases discussed in video with similar (matched) cases discussed in the co-located setting. These results are reported fully in [7]. The initiative was undertaken because it was apparent that videoconferencing meetings took up to 1/3rd longer than co-located MDT meetings, but it was not clear why this should be so. In that study we demonstrated that the additional time taken in videoconference was due to difficulty for those roles who were demonstrating features in images with a single video channel. (Since that study, a second screen was installed to maintain face-to-face views while reviewing image data in videoconference, and this has alleviated the situation somewhat.)

Observation at remote sites were conducted to experience the MDTMs from the remote perspective. A couple of observations are especially noteworthy:
- the remote team members had appropriated an overhead projector to display the incoming video onto a pull-down screen in preference to using the plasma screen display provided as part of the videoconferencing system. While this proved useful for those participants, it explained why they never seemed to ‘look’ at the main centre, since the camera is placed over the plasma screen and the participants have shifted sideways to look at the large display.
- the incoming video stream was freezing every couple of minutes, for periods of approximately 1 to 2 minutes. In a 45 minute recording, there were 23 ‘freeze events’ lasting between 7 seconds and 5 minutes - 30 seconds. This technical flaw had not been reported to the MDT participants at the main centre who were unaware that this was happening. The reason for this technical difficulty is unclear, and is being currently investigated. It seems to be related to either the use of a bridge connection between the ISDN lines being used to call from the main centre and an IP address at the remote site, or due to the fact that there is a need to switch between networks to transmit images from the main site, (or a combination of both reasons). Radiology is transmitted via the PACS system on a separate network, and pathology images are either from a digital image in presentation, or a microscope image on another organizational network. When remote participants were asked why they had not reported the difficulties they were experiencing they responded that they had mentioned it to Colleague several times. (But Colleague had no responsibility for the technology and did not pass on the information.) One senior MDT member said “we value the link with [Blank] hospital and we don’t like to complain. Its a lot better than it used to be - in the early days we had very snowy reception and you couldn’t really see anything”.

2.2. Discussion

Evaluating technology at MDT meetings has complications. The technology cannot be evaluated independently from the Use of the technology and the associated work processes. Neither can the MDT meeting Function be ignored. Laboratory simulation of the use of the technology would not capture issues of time constraints for the MDT in a hospital setting, nor would it identify contractual difficulties that influence how the technology performs. Whether or not the MDT meeting is satisfying its purpose as it conducts its business is a further important issue, as it is in the identification of shortcomings for which ICT solutions can be applied. Decisions taken at the MDT meeting need to be
recorded and communicated to the relevant individual who will perform the task. Ideally there would be a mechanism for feedback when the task is satisfactorily completed. The framework proposed in this paper (Figure 1) is an initial attempt to capture these various facets.

The potential for ICT support (such as decision-support tools) can be identified through analysis of the work undertaken at MDT meetings. Identifying appropriate research evidence and guidelines at the MDT meeting can be difficult, and the rational underlying the decision taken by the MDT can difficult to establish afterwards. Our study illustrates the importance of observing and listening to users as well as paying attention to organisational infrastructure where technology is employed.

Conducting an evaluation of the use of technology in a collaborative setting such as a MDTM, with several highly specialised roles who interact and share information in text, images and speech is a complex task. Developing an evaluation framework that takes account of the multitude of dimensions that are evident has the potential to improve the decision-making and ultimately patient outcomes, for those patients that are managed through these groupwork settings. Recognising the complex dynamics between MDT members and information, constrained by physical space and time dimensions, and mediated by technology, while acknowledging the organisational processes that also influence the conduct of the team, will potentially lead to the development of more advanced technological tools. Ultimately we can expect more efficient and effective work systems that will bring about patient satisfaction and greater well-being, and greater satisfaction for the staff involved. Having congruence between the technology, the organisational structures and users will ensure optimisation of the technology applied in complex settings.

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References