

Multidisciplinary Work Practices: A Comparison of Three Major European Hospitals

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Abstract—This paper reviews the practices of multidisciplinary teamwork (MDT) for cancer care in three large teaching hospitals in separate jurisdictions. Ethnographic observations provide the main source of data, which are verified through interviews, and in some cases by surveys and analysis of video recordings. We demonstrate how MDT practices develop among different groups, and in different jurisdictions. Common practices are identified and differences explained. Work practice analysis is an integral part of our research, and this study provides insights into medical teamwork and decision-making.

I. INTRODUCTION

Using data from two independent studies, this paper provides insight into how multidisciplinary teams (MDTs) function in different environments. We compare practices in Ireland, Sweden and Norway, and illustrate some common issues and variations that are influenced by differences in the local context. Our comparison is focused on the multi-functional role of the meetings, timing and co-ordination issues during the meetings, and access to information, as well as on the issue of MDT based care. Our aim is to identify commonalities and differences so that we can inform the model of MDT working and help identify areas where communication technologies might be employed in providing improved patient services. While we talk of MDT meetings (MDTMs) in general, we are using material from three examples, in two independently conducted studies, to inform those generalities. Long term observations with surveys and interviews were conducted at the gastrological surgical department at Karolinska University Hospital in Stockholm, and the cancer MDTs at St. James's Hospital in Dublin. A shorter term ethnographic study over one year was conducted at St. Olav's hospital in Trondheim. Other MDTs are considered from time to time in our comparisons.

A. Background

Over recent years there has been significant growth in MDT working [1], because of increasing specialisation, advances in medical technologies, including teleconferencing, and recommendations by respected agencies [2]. These developments have led to a need for highly specialised health professionals to engage in intense collaboration to provide effective services [3]. Building multi-disciplinary (or interdisciplinary) teams to address the complex problems arising in patient care can reduce health care system error [4]. The practice of MDTMs is becoming increasingly necessary and MDTs and MDTMs now

occupy a central role in developed health systems [5]. Patient management and outcomes have been shown to benefit from having their treatment managed in an MDT setting [6] and MDT working is now advised as a better way of organising health services for patients, particularly cancer patients [7]. MDT practice has become widespread, particularly in the United Kingdom, and MDTMs are being incorporated as a standard into cancer patient care pathways in Europe as well as in Australia and North America [8]. As benefits in cancer care are being appreciated, MDTMs are now advocated as the standard of care for a wider range of illnesses [9]. Despite the increasing interest in this form of working over recent years, there has been little focus on the context and content of MDTMs. Studies describe the conduct of the proceedings [10] or seek to identify the essential elements [11]. This study documents important variations in the conduct of MDT practices that provides further insight into their operation.

The Comparison Sites: The two large hospitals, Karolinska and St. James's, where long term studies were conducted are in different jurisdictions, and are similar in many respects: i) Both hospitals are the largest academic teaching hospitals in their respective countries. ii) Both were formed through the merger of smaller hospitals. iii) Both hospitals are designated cancer diagnostic and treatment hospitals in their respective healthcare structures. iv) Each hospital has over 1,000 beds and a large staff. The larger of the two hospitals has over 15,000 staff and the second hospital has approximately 4,000 staff. v) For both hospitals, there is pressure to maintain a minimum volume of a particular disease to maintain a high standard of care and develop competence. vi) In both hospitals the annual number of surgeries for any particular organ is increasing. vii) In both hospitals there has been a rapid development in MDT working over the past 10 years, and a significant proportion of time is spent in MDTMs. viii) Both hospitals utilise videoconferencing technology to extend the MDT services across multiple locations, including external institutions. The third hospital, St. Olav's in Trondheim, although not the largest in its jurisdiction is similar in size in many respects. St. Olav's has over 1000 beds and almost 10,000 employees. It is also a large cancer centre and, like other hospitals, has been experiencing rapid growth in MDT working over recent years, and utilises videoconferencing whenever necessary.

Expectations in Large Teaching hospitals: These three hospitals have similar pressures with regard to the development of standards of care within their range of services. Karolinska and St. James's hospitals are considered 'high volume centres', leaders in their fields. All three are expected to provide the highest quality in patient care. Quality standards and performance indicators for benchmarking in health care include post-operative mortality, 3-year survival rates, integrated care pathways and access to clinical trial programmes. Adequate case volume and appropriate and effective integrated clinical skill mix are expected. Both Karolinska and St. James's find that videoconferencing with other more rural hospitals facilitates national level MDTs to be developed and enables their volume to be maintained for highly specialised care. St. Olav's hospital links both to larger and smaller centres in its jurisdiction. Karolinska's connection with peer institutions enables collaboration at National level.

Rapid development: There has been rapid development of MDTMs at all three centres. Development has either been a condition of further service development (as at Karolinska), because of the hospitals tertiary referral status, and/or because of the proliferation of clinical practice guidelines that require patients to be managed by an MDT. At both Karolinska and St. James's the number of linkages to other hospitals has been growing, but development in the use of videoconferencing has not been as rapid as was expected 10 years ago. The increase in workload has been largely achieved through development of the work processes, and formalising and restructuring tasks that were hitherto conducted informally. Co-ordination has been improved and efficiency has been generated through MDT at a number of levels: getting materials (images and tissues) for pre-MDTM review to pathology and radiology in time, co-ordination of patient lists, co-operation, negotiation, teamwork and building on experience.

II. METHODOLOGY

Independent ethnographic studies were conducted at MDTMs in St. James's Hospital in Dublin and at Karolinska in Stockholm by authors BK and KG respectively. BK also conducted studies at centre three over a one year period. Both researchers utilised audio-visual recordings to verify their observations, and conducted surveys in the respective hospitals. Interviews were undertaken in all three settings. BK's ethnographic study commenced in 2004 and is on-going. From time to time the focus of her observations shifted to particular aspects or issues with the technology, the work systems, or MDTs. Similarly, KG's ethnographic study started in 2006 and is also on-going, although sporadic since 2012. Both studies have included a general focus on the patient care pathway (PCP), on technology used within the PCP, and on introducing new technological support for different activities in the PCP, or aspects of MDTMs. Following independent gathering of data, BK and KG compared observations and reviewed issues identified at each sites, retrospectively. These discussions were held in almost weekly meetings conducted over Skype in late 2009 to early 2010, and again over the period 2013-2014.

Ethical approval was given by the appropriate institutions to undertake this research. Emphasis is placed on examination of the work practices. No patient data are reported in this study.

Terminology used to describe the same phenomenon can be confusing. Teasing out meanings or differences in nuance can be revealing and can highlight important differences and perspectives. While each of us tends to use different terminology (MDTMs, 'Decision meetings', 'Post-op meeting'), when we discuss the meaning and activities behind the terms, we find that our processes and practices are similar. At St. James's the term "MDT meeting", or MDTM, is used to describe a meeting where all of the specialities involved in the patient's care come together, review the patient's clinical findings to date, and decide on the best next step in the patient's management. A patient may be discussed at several MDTMs: on initial presentation, after all tests have been conducted to agree the diagnosis, after treatment to review that the intervention was satisfactory, if any unusual or special circumstance arises, or if a review becomes necessary. Similar meetings are held at Karolinska, called Decision Meetings (DM). Other MDTM are convened for more defined purposes, with different terminology, at Karolinska, depending on their purpose. These MDT meetings, and the terms used to describe them, are defined in Table I. The nature of MDTMs at all three hospitals is similar. In addition, St. Olav's hospital has an additional type of MDTM where the patient is included.

Conducting research in the clinical setting: Both of us encountered similar challenges in conducting our independent research. At the outset hospital concerns to maintaining patient confidentiality were addressed and commitments given that all information is treated respectfully, and individual patient privacy is maintained. Because our work aims to improve the quality of the services, we were encouraged to undertake this research. However, we found it took time to build trust and co-operation and that as we grow more experienced and demonstrate our trustworthiness that the data being made available to us becomes more rich. We both find that investment in relationships with MDT members is critically important. As researchers we investigate issues and identify solutions that will support MDTs in their work. We need people to advise us of their experienced difficulties, and reveal their vulnerabilities from time to time. We must be sensitive to their situation, or our enquiries might be mistakenly interpreted as being critical evaluations of an individual's, or MDT's, work. We emphasise we use their experience to *inform* the model (or system) of MDT working, and our understanding of collaborative work, communication and interaction. We are *not* conducting a critical assessment of the quality of an individual's, or MDT's, effort. This distinction is important.

III. FINDINGS

Comparing our observations in the three countries, we examine the work process involved in patient care, or patient care pathways (PCP), and the decisions made at each stage in the process. MDT constitution is largely determined by the decisions to be taken and the roles involved. Factors such as

TABLE I
DEFINITIONS USED IN THIS PAPER WHEN DESCRIBING TEAMS, DISCUSSIONS AND MEETINGS

Acronym	Expansion	Definition
MDT	Multidisciplinary Team	A team that consists of a number of other clinical teams of different specialities, and has specialist roles within it. The patient is not present in most MDT practices, but has been observed with one MDT
PCD	Patient Case Discussion	A unit of an MDTM. Patient case details are evaluated among a number of different clinical specialists through discussion
CM	Co-ordinator Meeting	A meeting between the surgeon and radiologist to assess if there is enough patient information to proceed with a full PCD
MDTM	Multidisciplinary Team Meeting	A meeting of an MDT to discuss patient cases. These MDTMs may be video-mediated. This term MDTM, or MDT meeting is used in Dublin, and many Irish and UK centres.
DM	Decision Meeting	A special 'class' of MDTM that is video-mediated and at which the patient's diagnosis and management decisions are agreed for a set of PCDs. It is similar in practice to MDTMs, described in Dublin, and sometimes called 'a conference'.
PSM	Pre-Surgery Meeting	A special 'class' of MDTM for PCDs who are already scheduled for surgery. At Karolinska hospital, the surgeons meet with the radiologists and pathologists occasionally attend.
POM	Pre-Operative Meeting	A special 'class' of MDTM for PCDs whose surgery is completed and the patient has been discharged from care

volume of patients and difficulty in scheduling MDTMs are impacting factors. Our findings are discussed under the headings: decisions in the patient care pathway, the multifunctional role of MDTMs, the issue of co-ordination, team-based care, timing, volume of work and access to information.

The Patient Care Pathway: A common care process is evident across all jurisdictions, with small variations. The steps are identified in Table II. Most frequently MDTs conduct a

TABLE II
PATIENT CARE PATHWAY AND MDTM ACTIVITY

Action	Question / Decision
Initial referral from local primary care physician, or local hospital	Are further investigations necessary before meeting patient?
Initial investigations suspect cancer	Is enough information available for diagnosis? Are more tests needed?
Confirm diagnosis	All roles agree definitive diagnosis
Decide appropriate treatment	Which specialty can provide best treatment option?
Complications in care	All specialties discuss and agree appropriate action
Review post treatment (e.g. surgery)	Review decisions above and decide if further treatment is necessary

full patient case discussion (PCD) following completion of all the patient investigations (or 'work-up'), and the results of all the tests can be reviewed in conjunction with one another. A decision is then made on how the patient should be treated; whether surgery should proceed immediately, or if chemo- or radiation therapy should be given in conjunction with surgical treatment, and in which order these treatments should best be administered. At St. James's patients are reviewed again at the MDTM following their surgical resection, or other therapy, to confirm the initial diagnosis and decide how best to proceed in managing the patient. At Karolinska pancreas meetings, the post-operative PCD took place at a dedicated meeting (POM) after the patient had been discharged. Due to lack of time this practice was discontinued because it had lesser priority over other tasks. Sometimes, depending on complexity, a patient may be discussed by an MDT several times especially if there is a period of oncology treatment before the surgery (which is

often the case); and a patient may be discussed among several different MDTs. For example if a patient has synchronous primary tumours in anatomically different sites, such as kidney and oesophagus, (s)he is discussed at both Urology and GI Oncology MDTMs and is managed between two MDTs.

Occasionally at St. James's, a referral may be sent directly to an MDT member who may decide to consult with fellow MDT members on the appropriateness of the referral. In these infrequent cases, it may be the case that it is decided to refer the case to another MDT. MDTMs are occasions when the responsibility for a patient's care may be transferred from one clinician to another (at St. James's), or between one Department and another (at Karolinska). At Karolinska and St. James's there is a formal protocol for PCPs. A referral is sent through the EPR system, fax or paper mail. A secretary registers the information in the EPR system at Karolinska and a co-ordinator, examines the material to see if further investigations are needed before the DM. The co-ordinator role at Karolinska is assigned weekly to a senior surgeon, and this person is the contact for highly specialised care for remote hospitals. If no further investigations are needed the case used to be signed up for the co-ordinator meeting (CM), a pre-decision meeting where the co-ordinator and the radiologists together evaluated the quality of the material (imaging, test results etc). If the material was satisfactory to make a decision, the case was tabled for discussion at the DM. This procedure became unnecessary when a stage was reached where all cases tabled for the CM were of consistent high standard to proceed directly for DM discussion. Hence, the co-ordinator process refers cases directly for DM discussion. Although protocols are in place, workarounds from the formal protocol occasionally happen, usually when there is a time-critical condition.

Cases are reviewed again at a pre-surgical meeting (PSM), where a radiologist, and surgeons participate, and the focus is on the surgical strategy. (Pathologists occasionally attend the PSM.) In contrast to the clinical co-ordinator role at Karolinska, the co-ordinator role in St. James's is an administrative role; this person ensures that all the data are located and available for MDT discussion.

Multifunctional role of MDTMs: Patient management is the central purpose of an MDTM, but it serves other purposes too: teaching professional development, and important socio-emotional functions [12]. Many professional bodies now require that their members participate in MDTMs as part of their professional development (for example the Royal College of Pathologists). One of the radiologists at Karolinska said that *POMs are the ones where you get an answer to what you diagnosed* at the DM. She found POMs especially interesting, and the POM also served as a useful forum for gathering data for audit and quality improvement. Indeed the POM at Karolinska can be considered a special example where this audit function was given priority. However, due to lack of time and pressure of work these meetings have been cancelled. At St. James's, staff involved in auditing attend MDTMs and take notes; audit reports are presented to MDTs from time to time, with some of the key metrics of interest. These measures include the numbers of patients in the recent period, descriptive statistics on cases that includes the types of tumour and patient outcomes. Such metrics are handled at the care planning unit at Karolinska and through the quality registers.

TABLE III
ISSUES IN COMMON FOR MULTIDISCIPLINARY TEAMS

Theme	Description
Patient Care Pathway	MDTs are structured around the decisions being made in patient care
Multifunctional Role	MDTs fulfil several patient and organisation functions, such as patient care, education and training, audit and quality
Co-ordination	MDTs are co-ordination mechanisms. Correlation of independent diagnostic processes is facilitated. Complex services that require several specialist input in critical sequences are planned.
MDT-based care	Patients do better when managed by MDTs, and it is more satisfying for staff to work within MDT structures.
Timing	Many of the work processes are 'time critical' to be effective
Work Volume	Volume of Work continues to rise, exponentially
Access to Information	Could be improved, and more access to information is required
Related Work	MDTMs cannot be examined in isolation from the Pre- and Post- MDTM work processes in which it is embedded
Technology Use	There is a growing reliance on technology to manage the flow of information related to MDT work. PACs and videoconferencing are in widely used at meetings. Easier access to patient information is desired. Reliability is essential.

Co-ordination: MDTMs co-ordinate information from independent work processes. They are regarded as co-ordinating mechanisms for i) correlation of radiology, pathology and clinical investigations; and ii) planning surgery, radiation therapy and surgical treatments. Achieving consensus in diagnosis is described in [10]. For chemotherapy, surgery and radiation therapy, these treatments may be given either singly or in combination, administered in sequence or in parallel. Many treatments are delivered through complex protocols that need high levels of co-operation and co-ordination; and timing is critical. MDTMs improves communication on these decisions

and facilitate the efficient management of patient services. At Karolinska the treatment decision taken is notified to the Care Planning Unit by a surgeon (from the DM) because the Unit is not represented during the DM due to lack of resources. The Unit co-ordinates the patient's treatment, including the timings between different treatments, as necessary. Thus, the information shared during the DM discussion, and the decision in particular, is highly valued by the Care Planning Unit. The development of MDTMs has had impact on day-to-day work practices. Communication that was previously made in a random way between different specialists, is now scheduled. There are fewer interruptions in the work for many, because of regular MDTMs. For example, a surgeon may wish to discuss a patient's pathology result. Prior to having regular MDTMs a surgeon would discuss results with a pathologist directly by phone, or by calling to the laboratory. Because the doctor knows (s)he can discuss the case at the weekly MDTM, the necessity to make a special call to the laboratory is alleviated.

MDT-based care: MDTMs such as those described represent a shift towards team based care, where an MDT of medical specialities together decide about the treatment, (instead of an individual clinician). Together an MDT discusses different possibilities, making arguments by referring to scientific and personal experience. At the end, they reach a consensus about the diagnosis and the best possible treatment. Even though the decision is made in consensus with the others in MDTs, an individual clinician is held accountable for MDT decisions if there is an error in judgement. While it may sound contradictory that an individual might be responsible for a team decision, it reflects the anomalies currently being experienced in healthcare in the change process of transition from individual to MDT-based care. In practical terms it is expected that if the Consultant responsible for the patient is in disagreement with the views of an MDT then s/he would make their views known at an MDTM; the differences in opinion would be reconciled through discussion and an agreed plan of action would be determined. Records of attendance at MDTMs are maintained, but no record is taken of latecomers, or of those who may leave early. It has been recounted that because a surgeon was recorded as being present, it was assumed that s/he was aware of the latest decision on the patient. In fact the surgeon had left the MDTM and was unaware of the updated diagnosis and decision of the MDT. Differences in opinion are not uncommon, and have been observed between specialities. Differences are usually resolved through talk. Many see these arguments as 'healthy discussion' and are not discouraged. When two or more options are proposed with little difference in the long-term outcome from either treatment modality, it is usually agreed to present all the options to the patient, without any particular recommendation.

Timing: Collaborative work and co-ordination from a temporal perspective has been an area of interest in CSCW [13]. In our study of MDTMs timing is highly important and several points can be identified as 'time-critical' for the work system to be effective. From the patients perspective s/he must get appropriate care as quickly as possible to ensure the best

outcome. i) The clinician must get their patient onto the MDTM agenda. ii) The time between requesting a patient on the agenda and gathering the appropriate information for radiology/pathology review should be short. iii) MDT discussion should follow the review of these materials. iv) All the necessary specialities should be present in order to make a fully informed decision. v) Treatment decided by an MDT should follow closely after the decision, or else investigations will need to be re-done to evaluate disease progression before surgery. vi) Post-operative follow-up should be timely and within recent memory of the MDT for feedback to be effective. vii) Furthermore, the allocated MDTM time should be sufficient for satisfactory discussion on all of the patient cases tabled for discussion. As well as the timing of tasks and activities to make an individual MDT effective, a hospital needs to take account of the fact that several MDTs work in the hospital, and often share common resources such as operating theatres, out-patient clinics, etc.. Thus scheduling of MDTMs poses problems. As well as scheduling MDTM room locations, individual specialist roles need to be taken into account. For example, at St. James's there are four individuals to fulfil the integral role of medical oncologist in ten MDTs. Furthermore some consultant appointments are between two hospitals and schedules at both places must be synchronised. MDTMs take time, but they *save* time in other areas. As a junior doctor described: *"It saves so much time when you can have everyone there together [at an MDTM]. It saves us [house doctors] time asking pathology for the same report ... spending ages on the phone trying to get through to the lab ... and finding the number busy ..."* One reason why timing is so important is because of rapid disease progression in many instances. The time between diagnosis and treatment will affect the patient outcome. Generally, there are regulations regarding the time between the referral arrives and before it is evaluated; and the time between the decision and when surgery is performed. Clinicians are highly sensitive to the severity of specific cases and we have observed cases being prioritised because of clinical urgency. Such urgent cases are advised to all the MDT in advance to ensure that all disciplines, especially the radiologists, have time to prepare for the PCD. At each hospital, there is a similar, clear, structure of who presents, and in what order. This does not include a strict template for the information to be introduced during the PCD. It happens quite often that information that is important for the discussion is left out, or that possibly irrelevant information is introduced. Due to the large number of cases at a weekly MDTM, each case must be presented and discussed efficiently [14]. We observed efforts by MDTs to become more time efficient in their speech. For example, at Karolinska the time allowed for the radiology demonstration was considerably reduced. Specialists in-training are delegated responsibility to present information to MDTMs. When time pressure increases senior clinicians tend to take over the presentation of the patient's details and synopsise the account in the interest of time. If, for some reason, the time of the MDTM needs to be changed, it can be so complicated that its not possible, or

take years to negotiate. Several issues complicate changing an MDTM schedule: arranging for all of the individuals from different specialities and hospitals to be available together, and allowing time for preparation of material, especially for radiologists and pathologists, as the evaluation of radiology and pathology before an MDTM is particularly time consuming. Videoconferencing facilitates attendance at MDTMs, and MDTs are distributed over several geographical locations. The problems of supporting synchronous interaction are not fully resolved though since some staff may be scheduled to conduct patient tasks in another hospital (e.g. theatre session). Concerns for patient confidentiality and network security have, at St James's, resulted in restrictions being implemented so that connecting from outside the immediate hospital network is generally not facilitated. At Karolinska a procedure for connecting from outside the National Hospital Network was developed and is used weekly. One of the senior surgeons connects from his home, for example.

Volume of Work: All centres report a significant increase in demand for MDT services, and the number of patients being discussed in a multidisciplinary forum is continuously increasing. The rate of growth at St. James's is particularly noted and was the focus for a study reported fully in [15]. Work rhythms change over time as a function of the volume of work and technology changes, such as the use of a picture archive and communication system (PACS), videoconferencing and an electronic patient record (EPR). Constrained by time, there is a limit beyond which the volume of work can increase without impacting on the ways that teams conduct their work. At St. James's for example, one MDT has introduced a 'pre-MDTM' meeting to help identify those cases that need more investigations before full discussion can take place, and cases that can be dealt with quickly. A similar initiative at Karolinska was discontinued reported in section *Patient Care pathway* when the volume increased and the quality of information available was felt to be satisfactory. Maintaining cohesive teamwork, system dependability, and patient safety in the context of rapid change in the volume of work is a challenge.

Access to Information: All hospitals have Picture Archive and Communication Systems (PACS) fully implemented. There is a full electronic patient record (EPR) system used at Karolinska and St. Olav's. The EPR is partially implemented at St. James's. Thus, there is an essentially paperless system in Karolinska and St. Olav's; and both EPR and paper charts at St. James's. Within individual hospitals information can be accessed before an MDTM, but it is problematic for participants from remote hospitals to access necessary information. Although some groups of hospitals use the same EPR system, it is rare. Karolinska has developed a tool to facilitate greater information sharing among its group.

Technology Use: At each hospital there are MDTM room facilities, which can be located in Radiology, Pathology, or in a non-clinical area. In St. Olav's, MDTMs that include the patient, are held in a clinic area. All sites have electronic access to patient records and results. Most MDTM rooms are equipped with at least two large displays (for radiology

and pathology) and have capability for audio-visual link to several remote hospitals at once. The systems are configured so that the radiologist or pathologist can manage the controls they need, as well as manage the remote video connections. Echo-handling microphones are installed in the ceiling in all cases. Video and audio quality are important factors in video-mediated MDTMs. The bandwidth used needs to be sufficient to support audio and video quality, i.e. to pick-up subtle nuances in voices, and to secure that the movements of images does not produce blurry pictures at the receiving hospitals. The video-radiology system at Karolinska uses 1.5 Mbit/s (768 up and 768 down) bandwidths. The video protocol, H323, traverses several firewalls of different types. PCDs in videoconferencing have been found to take more time than co-located PCDs and the uptake in the development of videoconferencing linkages has not been as rapid as anticipated. Nonetheless, video-mediated MDTMs fulfil an important clinical function.

Reviewing Radiology Images: Hospital radiologists review patient imaging studies prior to PCD, and illustrate detail in the image through pointing and annotation while explaining their interpretation. For radiologists it is critically important that they have time to review the studies beforehand together with a clinical summary on the patient. They find it unsatisfactory to be presented with new image sets at an MDTM, or dislike being asked to provide an immediate assessment of an imaging study over a video-conferencing. Several issues are identified with respect to radiological imaging that applies in each setting: i) Standards in imaging protocols and formatting can differ between hospitals or institutions, and radiologists find it unsatisfactory to provide interpretation of imaging studies that conform to a different standard. If imaging studies are considered unsatisfactory, the patient may need to undergo repeat imaging for full radiological assessment which may result in a delay in the treatment decision. ii) Images transmitted in video-conferencing are usually of a lesser resolution and considered unsatisfactory for diagnostic purposes. iii) Radiologists (and pathologists) like to *consider* their opinion before commitment and dislike being asked to give an immediate response when presented with an image at an MDTM. iv) Sometimes the resolution of screens in the radiology department is higher than the monitors in MDTM rooms and the distinction is drawn between 'diagnostic quality' in the radiology department and a lesser 'teaching' or demonstration quality in the MDTM room. At Karolinska the radiologists use a radiology work station, but for the participants the images are projected on the wall from the ceiling projectors and a lesser quality image is visible to the general audience.

Reviewing Pathology: At St. James's, pathologists illustrate their opinion using either i) the processed slide from the original tissue sample using a microscope, or ii) in a slide presentation. Preparing a presentation in advance saves time at MDTMs, but because of time constraints beforehand, this is not always possible. It is the common practice to take digital photographs of resected (macro) specimens on arrival in the laboratory, that also show the orientation and sampling of the tissue, together with the images of diagnostic features at

microscopic level. Pathologists use these images at MDTMs to illustrate their findings. The pathologist's role is not always critical. The radiologist can dominate the PCD, when there is more radiological information available, that pathology, on the patient being discussed.

Technology breakdown: Karolinska and St. James's hospitals have experienced unacceptable technical breakdowns at MDTMs. Breakdowns can occur with the videoconferencing connections, the network, or PACS. Videoconference connection problems, video breakdown or audio distortions, or both, have been experienced. Difficulties with PACS involved loading images, problems with locating image readers, or difficulty in retrieving imaging studies from the archive even though images were prepared in advance. Although rare, St James's has had network failures in the past 5 years, while no failure in accessing the PACS system has been observed at Karolinska. The EPR has failed but is usually not accessed during MDTMs. When technical breakdowns occur, MDTMs generally try to continue without the full information being available on-line. St. James's staff have been observed using patient notes that have been brought to the MDTM. If the discussion becomes too difficult, the PCD is deferred until the next MDTM, or an arrangement is made for specialists to contact one another after the MDTM to discuss the case privately. MDTMs are dependent on technology. When poor performance or failure occurs, the technology becomes a source of irritation and frustration for health care staff. Issues can also be experienced with imaging studies from outside institutions, (scanned onto the local PACS) that have been conducted using different protocols, or methods of marking such as 'L' / 'R' or 'Top' / 'Bottom' indicators. These issues do not affect MDTMs directly as they are resolved in the review process.

TABLE IV
CONCERNS FOR MULTIDISCIPLINARY TEAMS

Concern	Significance
Time	There is a shortage of time
Tabling of patients for discussion	Too early, not enough information; too late, treatment delayed & poorer patient outcome
Information Availability	Patient history and all pathology and radiology images and opinion should be available
Reliable technology	Technology breakdown costs time and denies access to information
Informality	People like informality at work, but good communication practices often demand formality
Record-keeping	Systems for an authenticated record

Immediate Concerns: There are complex processes and issues to be examined when conducting research on MDTs. Although this paper does not discuss these in detail they are noteworthy and can be summarised as follows: i) Efficient tabling of patients on the agenda for discussion. If the patient is discussed too early, there are not enough results from investigations and patient will be re-tabled for discussion. The pre-MDTM assessment, which once was the CM and now only involves the co-ordinator review, at Karolinska avoids this pitfall. ii) Having all available radiology and pathology

on time for review for MDTM. iii) Time: there is a shortage. Scheduling is difficult and MDTM associated work processes must be synchronised for the system to operate. iv) Technology must be reliable and work both seamlessly and flawlessly. Technology breakdowns have a time cost, and put patients at risk. v) Recording informal notes at MDTMs leaves possibility for confusion. vi) Meeting record of the decision. MDTs want to improve record keeping at MDTMs to inform later work on the patient.

IV. DISCUSSION

Comparing MDTs provides insight into the clinical practices at three institutions. We believe our findings are generalizable and will benefit other hospitals. It is apparent that task-based structures with increased specialisation evolve to accommodate increasing workloads. Resources available will influence how these structures are shaped. For example if there is a limit on physical space available, it may not be possible to accommodate an MDTM at a particular time. If specialist services need to be delivered at two physical locations, then the time available for an MDT to meet in one location may be restricted. Several of the challenges facing MDTMs relate to timing. At all sites the number of cases being discussed has been growing over recent years. Thus each PCD must become even more time-efficient than before. Participants at MDTMs are constantly working on methods to reduce the time taken in discussion, and pre- and post- MDTM tasks, for example the time for radiology at Karolinska was reduced. But there is a limit to how much a PCD can be shortened. All relevant information must be presented. If the diagnosis is unclear, then different possibilities need to be considered, and the treatment options must be evaluated. We have witnessed PCDs becoming highly structured, and while defined structure yields benefits, there is a loss in the richness and quality in the talk. In an effort to make case decisions more ‘black and white’, subtle but important information detail may be lost. The turn towards MDT-based care that we experience is changing how health services are delivered. We can see a shift in roles and responsibilities. At most hospitals there are clear roles with responsibilities, including co-ordinator roles, who are accountable to the hospital and to the patient. Even though a decision is made in consensus, one person is held accountable. Due to the complex nature of many cases in a university teaching hospital setting, there are often borderline, or risky, decisions to be taken. Some people would advocate taking the risk with surgery, while others would argue against taking risks. In practice, we would like to see a decision record that would provide information on the basis for the decision, the options that were explored, the decision taken and the reasoning behind it. In current models of the EPR such a record is not yet accommodated.

V. CONCLUSION

MDTMs have become an important feature in medical work. The volume of patients will influence how MDT services are structured. More and more routine ‘business decisions’

in hospital work, that affect patients, are through group talk rather than in one-to-one communication methods of the past. Thus, the drive to find technological solutions to add dependability to the work system is paramount. We summarise the challenges facing developers of ICT in healthcare as being related to *time*, the *multifunctional* nature of MDTMs and shift to *multidisciplinary* teamworking. Time, timing and coordination are central, and finding ways so that several cases can be discussed in a limited time is a problem. Technology that might help in MDTM preparation, and save time during MDTMs will be welcomed. ICT should enable all relevant disciplines to participate in discussion, yet this has not yet been achieved in a satisfactory way. Comparing and contrasting MDT practices in these large teaching hospital institutions in different countries provides insight into the complex nature of interpersonal and inter-role collaboration at MDTMs. The importance of individual role participation, communication and MDT cohesiveness is especially highlighted. The problems of providing technological support may seem unsurmountable, but we believe that by increasing our understanding of the many facets of the setting that solutions will emerge.

REFERENCES

- [1] T. Ruhstaller, H. Roe, B. Thürlimann, and J. J. Nicholl, “The multidisciplinary meeting: An indispensable aid to communication between different specialities,” *European J Cancer*, vol. 42, pp. 2459–2462, 2006.
- [2] K. Calman and D. Hine, *A Policy Framework for Commissioning Cancer Services*. Department of Health, Welsh Office, 1995.
- [3] A. Arnaudova and E. Jakubowski, “Eight futures forum on governance of patient safety,” World Health Organization, Denmark, April 2005.
- [4] J. Øvretveit, *Integrated quality development for public healthcare*. Norwegian Medical Association, 1999.
- [5] N. Houssami and R. Sainsbury, “Breast cancer: Multidisciplinary care and clinical outcomes,” *Europ J Cancer*, vol. 42, pp. 2480–2491, 2006.
- [6] M. Birchall, D. Bailey, and P. King, “Effect of process standards on survival of patients with head and neck cancer in the south and west of England,” *British J Cancer*, vol. 91, no. 8, pp. 1477–1481, 2004.
- [7] F. C. Wright, C. De Vito, C. Langer, A. Hunter, and the Expert Panel on Multidisciplinary Cancer Conference Standards, “Multidisciplinary cancer conferences: A systematic review and development of practice standards,” *European Journal of Cancer*, vol. 43, pp. 1002–1010, 2007.
- [8] C. Balding and J. Anderson, “Clinical excellence in cancer care: a model for safety and quality in Victorian cancer services,” Metropolitan Health & Aged Care Services, Victoria Gov., Australia, Tech. Rep., Feb 2007.
- [9] M. Jefford, R. Jennens, T. Speer, and V. Thursfield, “Different professionals’ knowledge and perceptions of the management of people with pancreatic cancer,” *Asia-Pacific J Clin Oncology*, vol. 3, pp. 11–51, 2007.
- [10] B. Kane and S. Luz, “Achieving diagnosis by consensus,” *Computer Supported Cooperative Work (CSCW)*, vol. 18, no. 4, pp. 357–392, 2009.
- [11] S. Brar, C. Provvidenza, A. Hunter, J. C. Victor, J. Irish, R. McLeod, and F. Wright, “Improving multidisciplinary cancer conferences: A population-based intervention,” *Annals of Surgical Oncology*, vol. 21, no. 1, pp. 16–21, 2014.
- [12] G. Hardstone, M. Hartswood, R. Proctor, R. Slack, and A. Voss, “Supporting informality: Team working and integrated care records,” in *CSCW Chicago 2004*, ACM. ACM Press, 2004.
- [13] M. C. Reddy, P. Dourish, and W. Pratt, “Temporality in medical work: Time also matters,” *Computer supported Co-operative Work (CSCW)*, vol. 15, no. 1, pp. 29–53, 2006.
- [14] K. Groth, O. Frykholm, R. Segersvard, B. Isaksson, and J. Permert, “Efficiency in treatment discussions: A field study of time related aspects in multi-disciplinary team meetings,” in *IEEE Computer-Based Medical Systems (CBMS)*. Albuquerque, USA: IEEE, 2009, pp. 1–8.
- [15] B. Kane and S. Luz, “Do no harm: Fortifying MDT collaboration in changing technological times,” *International Journal of Medical Informatics*, vol. 82, no. 7, pp. 613–625, 2013.