Use of videoconferencing to enhance care and improve health-care efficiency

Multidisciplinary team meetings have proven benefits in reducing waiting times for diagnosis and treatment, but they increase pressure on clinicians and require new measures to improve workplace efficiency. Using videoconferencing in the multidisciplinary team meeting can enhance and improve health-care efficiency.

Since the publication of the Calman–Hine report in 1995 the multidisciplinary team meeting has become a cornerstone in managing patients with cancer within the NHS. The early objective was to ensure that all patients had equal access to a high and consistent standard of care regardless of their geographical location or to whom they had been referred (Haward, 2006). However, it was recognized that there were too many variations in the quality of care and treatment across the country. The Calman–Hine report, and subsequent NHS Cancer Plan of 2000, proposed a more equitable level of access to high levels of expertise throughout the UK. As a result, the Cancer Services Collaborative was established. Experience from the Cancer Services Collaborative showed that through multidisciplinary team meeting working it is possible to reduce waiting times for diagnosis and treatment by several weeks. For example, the West London and Environs Cancer Services Collaborative team reduced the wait from first appointment to the start of treatment for patients with lung cancer from 28 to 8 days (Department of Health, 2000).

In the two decades since the Calman–Hine report, care pathways and treatment options for cancer and other complex cases have continued to evolve with increasingly specialized and complex management plans. A large number of multidisciplinary team meetings have also started taking place for non-malignant conditions.

Thousands of multidisciplinary team meetings now take place within the UK (Fleissig et al, 2006), with estimated costs to the NHS of approximately £50 million a year for preparation and a similar amount for attendance time (Taylor, 2010). The growth in multidisciplinary team working has placed particular pressure on the NHS (Kane et al, 2007). Surgeons discussing patients are not operating, radiologists or pathologists presenting cases are not at their workstations (Munro and Swartzman, 2013). Many clinicians now belong to many different groups and contribute to multiple multidisciplinary team meetings across geographically disparate locations. Time management, scheduling and travel between sites are significant threats to effective multidisciplinary team meetings (Kane et al, 2007).

These challenges have led to new approaches to manage work and still maintain a physical presence at multidisciplinary team meetings. Within North Bristol NHS Trust, after a pilot study in 2008, a videoconferencing system was successfully installed to help tackle some of the challenges faced in the modern NHS. This article discusses the conferencing solutions available to NHS organizations and their respective advantages and disadvantages, and also shares the authors' experience of this technology in improving patient care, saving costs and reducing CO_2 emissions.

Conferencing solutions: what are the options?

Health-care institutions are now realizing the benefit that face-to-face online interaction brings to their organization and, as a result, are looking to adopt conferencing solutions that meet their needs while staying within budget. Two principal digital formats are available – webconferencing or videoconferencing – each with its own advantages and disadvantages.

Historically, webconferencing and videoconferencing were seen as separate platforms with particular advantages and disadvantages. Webconferencing has typically been used to disseminate large amounts of data to a large group of people with little in the way of feedback or checking of understanding, i.e. webinars or webcast conferences. Videoconferencing has involved communication between individuals, or a group of individuals, with the opportunity for direct person–person interaction and feedback.

However, as these technologies have developed the difference between them has become blurred. Webconferencing applications are adding two-way videocapabilities and videoconferencing applications include the ability to share content and present in unison with video. Similarly, both webconferencing

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and videoconferencing now offer cloud-based solutions ensuring users have the flexibility to meet from any device, from anywhere and at any time. This has led to a congested marketplace with multiple vendors offering different conferencing solutions for a wide range of budgets.

Dedicated videoconferencing suites

Typically this takes the form of a desktop-based videoconferencing system in a dedicated room or suite (Nefsis, 2016). This provides the highest quality audio and video solution to deliver the most immersive videoconferencing experience. With dedicated suites, meetings can be conducted at scheduled times enabling workforce planning and meetings to be organized well in advance. Similarly, the success of videoconferencing relies on the ability to maintain the 'human connection' facilitating communication not hindering it. This makes a dedicated and properly set-up room a key requirement to facilitate user interaction and communication.

However, such dedicated videoconferencing systems and suites are expensive and require considerable investment, both in terms of room allocation and in IT support networks. This can be a barrier for some smaller organizations or in situations where budgets are being tightly managed. Access to these suites may also be limited requiring a system to be in place to 'book' or 'reserve' the room in advance. This may hinder users who have a high frequency of spontaneous or unexpected videoconferencing needs.

Cloud-based videoconferencing platforms

While the majority of dedicated desktop-based platforms do offer cloud-based videoconferencing enabling any device, anywhere and anytime connectivity, a number of providers offer systems with significantly reduced hardware/software requirements.

For example, Zoom, Vidyo, Omnijoin, BlueJeans and the CISCO systems-affiliated Webex are just some such providers. The key focus of these systems is around accessibility. They provide high quality videoconferencing platforms instantly using any device with little requirement for expensive hardware or IT support structures to be in place. Often at the touch of a button users are able to take part in a meeting using screen-sharing technologies, high quality audio and video at a fraction of the cost of a dedicated videoconferencing suite. Users can initiate contact on their own with a minimal learning curve and participants do not need any special knowledge in order to intuitively interact in the meeting environment. This makes these platforms an attractive option for many institutions, particularly smaller or medium-sized organizations or in situations where budgets are tightly managed.

However, the very appeal of these systems may also be one of their downsides. To ensure a productive and efficient meeting users need to feel involved and engaged, which can be difficult when they are connected from a variety of non-optimized locations or devices, i.e. mobile phones, iPads or laptops. Issues can arise with background noise, lighting and poor sound quality, all of which hinder communication rather than facilitate it, leading to frustration among users.

A variety of videoconferencing solutions is available to the health-care sector each with its own advantages and disadvantages. However, to facilitate and enhance multidisciplinary team working it is essential that communication between health-care professionals, workflow and travel time are optimized to ensure the highest standards of patient care are maintained and the success of the multidisciplinary team meeting.

Getting the most from a video-linked multidisciplinary team meeting setup

While numbers in attendance at particular multidisciplinary team meetings vary, in the authors' experience, the meetings typically comprise at least one consultant radiologist and one radiology registrar, one consultant surgeon (often two or three) and one surgical specialty registrar or senior house officer (often two), one consultant pathologist, one consultant oncologist, two (often three) consultant physicians, medical specialty registrars or senior house officers (often one or two), clinical nurse specialist (at least one), allied health professionals depending on the meeting (two or three), and one multidisciplinary team coordinator. As such, many of the authors' multidisciplinary team meetings comprise at least 10–12 people with the larger meetings often having 15 or more individuals in attendance.

Typically, either one or two district general hospitals will join the multidisciplinary team meeting via videoconferencing facilities. While numbers vary there are often between two and five people accessing the multidisciplinary team meeting remotely.

To get the most out of a video-linked multidisciplinary team meeting, it is crucial that the room or suite is set up correctly. Criticisms of videoconferencing systems in the past often related to poor installation, particularly in terms of inadequate lighting and sound, poor video display and a lack of inclusivity (Kane et al, 2007). By following a few simple rules many of these barriers can be overcome and the system can be used optimally.

Room layout

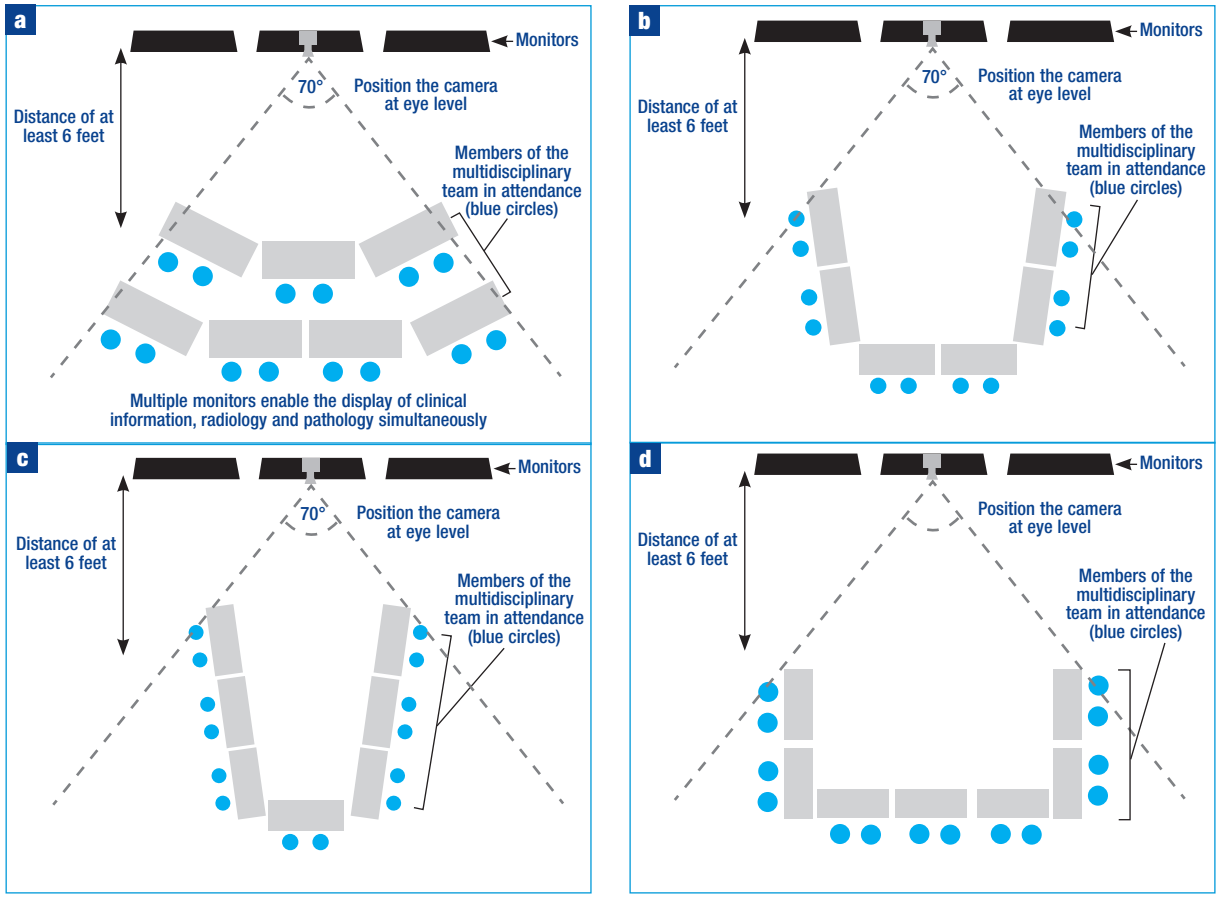
The majority of clinical multidisciplinary team meetings now take place in small–medium sized seminar rooms. The setup depends on the number of people attending the meeting and also the type and number of display screens used (*Figure 1*).

It is important to ensure that all users are included within the camera's field of view (typically 65–75°). Ideally access should be from behind or to the side of the camera so that people do not have to walk in front of the camera to sit down.

Room décor and ergonomics

White walls should be avoided as this can cause reflective glare. Light blue or grey colours or soft-textured wall

Figure 1. Three-monitor digitally integrated display and front located camera. Suggested room layouts to ensure optimization of the videoconferencing experience for all users. **a.** Trapezoid, **(b)** U-shape (useful for medium-sized meetings), **(c)** shallow V-shape and **(d)** V-shape (c and d are useful for larger multidisciplinary team meetings involving 14+ individuals).



coverings are better if possible (Bretford Manufacturing Ltd, 1999; Woolley, 2008). Avoiding patterned walls and furniture also optimizes the user interface. Key members, especially those sitting for a long time during multidisciplinary team meetings, should have height-adjustable chairs in order to prevent posture-related neck or back pain, and musculoskeletal fatigue (Prabhu et al, 2005).

Lighting

Modern systems work optimally at light levels between 75 and 100 lumens/square foot (Woolley, 2008). All natural sources of light should be avoided by using blackout blinds or using a room with no windows. Uniform, indirect fluorescent lighting using a mixture of overhead and wall lights is optimal as this reduces shadows in the room and bright spots on the display screens. Wall lights should shine light upwards to the ceiling to avoid creating shadows on people's faces, with a recommended proportion of ceiling to wall lighting being ~60/40 (Bretford Manufacturing Ltd, 1999; Woolley, 2008).

Acoustics and audio

Environmental noise should be minimized by choosing a room that is not off a main corridor and is away from communal areas. Reverberation artefact will reduce the sound quality during use, but installing sound absorption panels across as little as 10% of the total wall area can greatly reduce this reverberation effect. Some videoconferencing systems have microphones built in to the camera. These typically have a functional range of 10–15 feet. Depending on the size of the room, smaller plug-in and mobile microphones may be needed to ensure adequate coverage.

Visual

It is essential to install high quality monitors. Direct-lit LED technology delivers sharp, high-resolution images with up to 50% energy savings compared to traditional CCFL-backlit displays. This provides 1920 x 1080 full HD resolution for bright, vivid and sharp images suitable for diagnostics in the video-linked multidisciplinary team meeting setting.

Training and maintenance

Good IT support is also crucial for reliable and uninterrupted conferencing. The importance of having an adequate support contract and team cannot be overstated, as the impact on patient care of cancelled multidisciplinary team meetings caused by equipment failure is a significant concern and must be minimized.

Technical, data protection, networking and security

A network IT expert or team is essential to configure and secure video links at each hospital which needs to participate in video-linked multidisciplinary team meeting. These services may not be available at smaller hospitals although this can be overcome by sharing IT know how and the 'parent unit' taking charge of running the regional video-linked multidisciplinary team meeting network. A poorly configured or inadequately secured videoconferencing system is susceptible to cyber-attack, allowing unlawful access to patient confidential data. It is imperative that up-to-date virus and malware protection is in place with a dedicated and secure virtual private network connection between all hospitals.

Audio and video signal lag

A latency or time lag greater than 200 ms is usually noticeable and often distracting (Percy, 1999). With improved audio video compression and increased broadband speed, this technical issue is not a hindrance to modern videoconferencing.

Change in behaviour on camera

There can be problems with maintaining adequate eye contact during a videoconference, which plays an important role in effective face-to-face conversation (Ott et al, 1993). Cameras located in the screens or as close as possible to the display units can overcome this problem and also reduce the effect of parallax. Camera and appearance consciousness is another psychological barrier to successful videoconferencing.

Eight years' experience

North Bristol NHS Trust is the largest hospital trust in the south west of England, providing hospital and community health care to the residents of Bristol, South Gloucestershire and North Somerset. It has over 800 inpatient beds and treats upward of 300 000 patients per year. North Bristol NHS Trust is a tertiary referral centre for a large number of specialities while radiotherapy and bone marrow transplant services are available at the neighbouring Bristol Haematology and Oncology Centre under University Hospitals Bristol NHS Foundation Trust.

Just like other geographically disparate patient populations and centralized tertiary services, this presents a considerable challenge for effective patient management, particularly for oncological services. The Trust frequently treats patients living in Cornwall or Devon (up to 150 miles away), undergoing local radiological imaging but subsequent discussion at centralized or tertiary oncology units.

A desktop-based videoconferencing system is operated in three dedicated suites that use multi-screen technology, enabling clinical, radiological and pathological information to be shared with all participating NHS users simultaneously across multiple sites (*Figures 2* and *3*). This enables cases to be referred between trusts more efficiently.

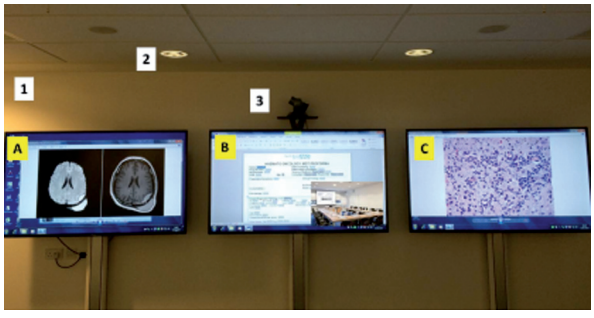


Figure 2. A typical videoconferencing multidisciplinary team meeting IT setup: three-monitor digitally integrated high resolution screens (A, B and C) are capable of displaying radiology images, case notes, lab results and pathology specimens in addition to video feeds from other locations as required. Uniform, indirect fluorescent lighting is used with a mixture of (1) overhead and (2) wall lights. 3. A front-located camera is mounted with a 65–75° field of view.

Figure 3. Typical radiology, multidisciplinary team coordinator and pathology setup for a videoconferencing multidisciplinary team meeting. A. Workstation for radiologist. B. Computer for multidisciplinary team coordinator. C. Microscope and PC for pathologist. 1. A wall-mounted camera with a 65–75° field of view. 2. Microphone.

The first videoconferencing setup in 2008 cost approximately £65 000. Since then, three new video-linked multidisciplinary team meeting suites have been installed at an average cost of £25 000. The potential cost savings of these systems were calculated as £4342 for five staff earning £40 000pa, travelling independently to and attending a biweekly multidisciplinary team meeting at another location (26 meetings/yr). Travel time can be deemed as 'non-productive'. These savings for five people in monetary terms were enough to justify the cost of a videoconferencing room system. In addition, the estimated CO_2 saving was 2958 kg per annum. Within this region, the hospital trusts are within a few miles of each other. In even more geographically disparate regions the cost of a videoconferencing system could be recouped within a few months. The reduced setup and purchase costs for a videoconferencing system, combined with ever-increasing

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travel costs, mean that the average return on investment in a videoconferencing room is now better than in the last decade.

Internet-based ready reckoners are available on most equipment vendor's websites, for example www.internet-video.co.uk/calccheck.lasso or http://videolease.co.uk/calculate-roi

There are also tools which can compare cost savings for over 30 online meeting software, for example https://webconferencing-test.com/en/compare-pro

These tools can help individual NHS trusts to calculate efficiencies from non-productive staff hours resulting from the need to travel. Smaller organizations can also consider either leasing the video-linked multidisciplinary team meeting equipment or choose a setup fully managed by the technology company.

Discussion

Over recent years, there has been an increasing demand for review of pathology and radiology findings at multidisciplinary team meetings. These meetings aim to ensure that all patients with cancer or other complex conditions benefit from the knowledge and experience of a wide variety of professionals. They offer an integrated approach to health care enabling clinicians to consider relevant treatment options and collaboratively develop a individual treatment plan for patients (Fleissig et al, 2006; Molleman et al, 2010). However, there has also been an increasing trend for sub-specialization in almost all clinical areas, including radiology and pathology. As such, multidisciplinary teamwork is recommended because of this increasing complexity in patient management (Ke et al, 2013). Research indicates that multidisciplinary team meetings in cancer care are associated with reduced time from diagnosis to treatment (Gabel et al, 1997), more accurate pathological staging of disease (Davies et al, 2006), improved survival (Kesson et al, 2012) and greater patient satisfaction (Boxer et al, 2011). For the benefits of the multidisciplinary team meeting to continue it is necessary to overcome hurdles presented by geographically disparate locations, centralization of specialist services and additional pressures on clinician time.

Presence at multidisciplinary team meetings provides an important forum for inter-professional communication, feedback and peer review. A common complaint among radiologists and pathologists is a lack of pertinent clinical information on the request card at the time of the examination; similarly, clinicians may find terminology and form of expression in reports unclear. Multidisciplinary team meetings provide a forum for updating colleagues and offering continued professional development to attendees. The development of personal relationships and inter-professional communication during a multidisciplinary team meeting helps combat these issues, and enables common ground to be developed, thereby improving patient care (Packetizer, 2016). Modern videoconferencing systems enable professional interaction to take place from remote sites with no audio or visual time delays, giving an authentic and realistic experience, and making users feel like they are actually there.

Education and clinical governance are essential aspects of the multidisciplinary team meeting. Development of specialist centres across the UK has led to greater sub-specialization among clinicians. However, in district general hospitals there is a danger that this sub-specialization leads to knowledge gaps, lack of exposure to particular cases and perhaps even professionals becoming de-skilled in certain areas. The opportunity to provide a videoconferencing presence for such professionals can help to combat this problem. Individuals would be able to take part in regional or national multidisciplinary team meetings without the need to travel and the associated impact this would have on their daily work and the environment. Similarly, ensuring maximum clinician expertise at meetings also aids recruitment of patients into clinical trials and audits, and ensures that patients receive optimum care and are allocated to the most appropriate treatment pathway.

It is crucial that attendance at multidisciplinary team meetings is made as easy as possible for all clinicians, keeping attendance rates high and ensuring quality of care is maintained (Maskell, 2013). Videoconferencing systems facilitate clinician attendance independently of their base hospital or scheduling commitments.

The cost of travel between connecting sites in terms of loss of working hours, as well as the environmental impact, should not be underestimated. For example, according to online emission calculators, the 5.5-mile journey between two of the major centres in North Bristol NHS Trust (Southmead Hospital and Bristol Haematology and Oncology Centre) results in emission of 190.4 g CO_2/passenger km for each journey. This simple 5.5-mile journey is through the centre of the city with very limited access to parking at either hospital site, so a reasonable estimate of door–door journey time is in the region of 60 minutes. Eliminating the need to travel enables clinicians to spend this additional time fulfilling direct clinical commitments. Similarly, clinicians who would normally not be able to attend a particular multidisciplinary team meeting because of scheduling issues could do so from remote sites.

Videoconferencing within the multidisciplinary team meeting setting has not been universally welcomed. Indeed, Kane et al (2007) even suggested that virtual multidisciplinary team meetings can be a potential source of harm. They raise concerns over videoconferencing placing extra coordination demands, taking longer than face to face discussions, disrupting the work rhythms of the specialists

involved and impacting on socioemotional factors within meetings. To maintain the benefits of multidisciplinary team meetings for patient care in the current climate the authors believe that a correctly installed, setup and maintained videoconferencing suite is essential. This will only serve to enhance inter-professional collaboration and enable different professional groups to work together to positively impact health care (*Table 1*).

Conclusions

Cancer care is evolving and multidisciplinary team meeting work is expanding and requiring expert input. Clinicians face ever-increasing pressures in terms of patient numbers, demands on their time, maintaining adequate clinical governance and communication across geographically disparate locations. The video-linked multidisciplinary team meeting offers a solution to a number of problems. It ensures clinical time is used as efficiently and effectively as possible while also allowing expert opinion to be shared across the region. This enables rapid referral of patients to oncological or tertiary services, ultimately benefitting patients and improving patient care. **BJHM**

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Table 1. Potential benefits of videoconferencing multidisciplinary team meetings

Improved coordination between clinical, pathology, radiology and nursing teams
Review of results at multidisciplinary team meetings and refinement of pathology and radiology reports where necessary
Improved decision making from expert opinion
Coordination of patient management
Enhanced inter-professional communication
Improved feedback and peer review
Education, research and recruitment in clinical trials
Travel-related cost saving, improved productivity and environmental benefits

KEY POINTS

- Videoconferencing within the multidisciplinary team meeting can help to ensure that clinical time is used as efficiently and effectively as possible.
- With the advent of modern IT systems and fast broadband connections it is now possible to maintain real-time HD multiparty video calls across multiple locations. Reduced hardware costs and competition between manufacturers has been beneficial for trusts, with a rapid return on investment which is now estimated at 12–18 months.
- A correctly setup suite with appropriate décor, room layout, lighting and audio, backed up by good technical support, is key to ensuring a reliable and efficient videoconferencing multidisciplinary team meeting.
- Use of videoconferencing in the multidisciplinary team meeting ensures patients have equitable access to high quality and consistent standards of health care irrespective of their geographical location.
- Expert opinion can be shared and accessed across regions, patients can be discussed and referred rapidly, clinician work-flow is optimized by reducing commuting times and inter-professional communication is improved.

Boxer MM, Duggan KJ, Descallar J, Vinod SK (2011) Do multidisciplinary team meetings make a difference in the management of lung cancer? *Cancer* **117**(22): 5112–20 (doi: 10.1111/ajco.12421)
Bretford Manufacturing Ltd (1999) Bretford's Guide to successfully planning a videoconferencing room. www.rbha.net/Library/Video_Conf_Guide.pdf (accessed 17 February 2016)
Davies AR, Deans DA, Penman I et al (2006) The multidisciplinary team meeting improves staging accuracy and treatment selection for gastro-esophageal cancer. *Dis Esophagus* **19**(6): 496–503 (doi: 10.1111/j.1442-2050.2006.00629.x)
Department of Health (2000) *The NHS cancer plan: a plan for investment, a plan for reform.* Department of Health, London
Fleissig A, Jenkins V, Catt S, Fallowfield L (2006) Multidisciplinary teams in cancer care: are they effective in the UK? *Lancet Oncol* **7**(11): 935–43 (doi: 10.1016/S1470-2045(06)70940-8)
Gabel M, Hilton NE, Nathanson SD (1997) Multidisciplinary breast cancer clinics. Do they work? *Cancer* **79**(12): 2380–4 (doi: 10.1002/(SICI)1097-0142(19970615)79:12<2380::AID-CNCR12>3.0.CO;2-N)
Haward RA (2006) The Calman-Hine report: a personal retrospective on the UK's first comprehensive policy on cancer services. *Lancet Oncol* **7**(4): 336–46 (doi: 10.1016/S1470-2045(06)70659-3)
Kane B, Luz S, O'Brian S, McDermott R (2007) Multidisciplinary team meetings and their impact on workflow in radiology and pathology departments. *BMC Med* **5**: 15 (doi: 10.1186/1741-7015-5-15)
Ke KM, Blazeby JM, Strong S, Carroll FE, Ness AR, Hollingworth W (2013) Are multidisciplinary teams in secondary care cost-effective? A systematic review of the literature. *Cost Eff Resour Alloc* **11**(1): 7 (doi: 10.1186/1478-7547-11-7)
Kesson EM, Allardice GM, George WD, Burns HJG, Morrison DS (2012) Effects of multidisciplinary team working on breast cancer survival: retrospective, comparative, interventional cohort study of 13 722 women. *BMJ* **344**: e2718 (doi: 10.1136/bmj.e2718)
Maskell G (2013) Commentary on: Does every patient need to be discussed at a multidisciplinary team meeting? *Clin Radiol* **68**: 760–1
Molleman E, Broekhuis M, Stoffels R, Jaspers F (2010) Consequences of participating in multidisciplinary medical team meetings for surgical, nonsurgical, and supporting specialties. *Med Care Res Rev* **67**(2): 173–93 (doi: 10.1177/1077558709347379)
Munro AJ, Swartzman S (2013) What is a virtual multidisciplinary team (vMDT)? *Br J Cancer* **108**: 2433–41
Nefsis (2016) Video conferencing history. www.nefsis.com/best-video-conferencing-software/video-conferencing-history.html (accessed 16 February 2016)
Ott M, Lewis JP, Cox I (1993) Teleconferencing eye contract using a virtual camera. INTERACT '93 and CHI '93 Conference Companion on Human Factors in Computing Systems, Amsterdam, The Netherlands, April 24–29: 109–10 (doi: 10.1145/259964.260136)
Packetizer (2016) A history of video conferencing technology. www.packetizer.com/ipmc/history-of-videoconferencing (accessed 15 February 2016)
Percy A (1999) Understanding latency in IP telephony. www.aitel.hist.no/fag/ipt/lek02/iptel_latency_brooktrout.pdf (accessed 17 February 2016)
Prabhu SP, Gandhi S, Goddard P (2005) Ergonomics of digital imaging. *Br J Radiol* **78**: 582–6 (doi: 10.1259/bjr/51650129)
Taylor C (2010) Multidisciplinary team working in cancer: what is the evidence? *BMJ* **340**: c951 (doi: 10.1136/bmj.c951)
Woolley S (2008) Creating a Technology-Enhanced Conference Room. www.buildings.com/article-details/articleid/6007/title/creating-a-technology-enhanced-conference-room.aspx (accessed 17 February 2016)