


Education Departments' Superhighways Initiative

Group E: Higher and Professional Education

Final Report

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Notes on the evaluation

1. The evaluation was conducted in three parts:

   Part One – Investigation of current courses using semi-structured interviewing and observation

   This phase of the evaluation involved observing all live-links sessions over a period of 3 months. The evaluator carried out informal interviews and group reflections with all the tutors and trainees taking part. The views and experience of staff at the College, including the technical and support staff and those designing and administering the courses, were also very relevant to this evaluation. Formal interviews with a range of College technical and administrative staff were also carried out.

2. *Part Two – Exploration of live links for skills training and application in surgery using structured interview by telephone*

   This second phase of the evaluation involved preparation of a telephone-interview schedule based on the results of the first phase interviews. Five tutors of the courses, 10 of the consultant surgeons and 10 specialist registrars who had attended them, were interviewed in depth. The interviews focused on the contextual and pedagogical factors associated with learning from live links and, crucially, applications of this learning to surgical practice.

3. *Part Three – Extension of live-links technology and applications*

   The integration and extension of live-links technology with other technologies for more effective learning, and its use for other audiences, were explored at all stages of the evaluation. Conclusions and indications are presented and discussed.

Section 2

Project Information

1. LIVE-LINKS PROJECT FOR SURGICAL TRAINING

Project background

1.1 The focus of this report is on the use of live television links between an operating theatre in a regional hospital and the central teaching establishment in London at the Royal College of Surgeons. The live-links system is part of a wider development, but is free-standing in its use. Complementary educational technologies at the College have been evaluated independently of the current study.

Details

1.2 The Raven Department of Education was established at The Royal College of Surgeons of England in 1992 to provide postgraduate education for surgeons in training and consultants in independent practice, in line with the College's responsibility to maintain the standards of surgery in England and Wales.

1.3 The Department has entrained several major development projects:

- The Minimal Access Therapy Training Unit (MATTU), funded by the Department of Health and Wolfson Foundation, is a specialist facility intended to teach minimal access (laparoscopic) techniques for all surgical and non-surgical disciplines. The College now has responsibility for funding MATTU and running costs are largely covered by course fees.
- The Wolfson Surgical Training Centre, funded by the College and the Wolfson Foundation, provides a multi-purpose practical training facility.
- The Hill Surgical Workshop, funded by Mr D. Hill, provides a highly specialised facility in which anatomical work is combined with state-of-the-art simulation materials in an environment similar to that of the operating theatre.

1.4 The College is committed to the provision of high quality courses and has taken an innovative approach by introducing methods of teaching and learning that have not previously been used in this sector of education, e.g. distance learning programmes, computer-assisted learning and standardised practical workshops that can be attended regionally rather than at the College.

1.5 The first live-links course ran in October 1993.

Description of the technology

1.6 The live links at the College consist of a fibre-optic line to the Royal London Hospital and a dial-up 2Mb/sec Mercury switchband link to the Royal Surrey County Hospital, St Mary's Hospital Paddington and to two other hospitals in Leicester and Liverpool. The system provides one-way video and two-way audio into three rooms in the College. Two are teaching rooms, holding 30–40 people and the third is a large lecture room, seating up to 300.

1.7 Each of these rooms is also equipped to handle a wide range of presentation media (video, slides, data) that can be controlled by the tutor via a touch panel. As the College's brochure on their facilities states:

> *The lectern mounted touch panel gives operator control of all the presentation functions including the A-V equipment, all the on-line services and control of sound and light level. The control panel allows both regular tutors and visitors to take full advantage of all facilities without any technical 'know how'.*

1.8 This easy interface is relevant to the use of the interactive television, as one of the tutors acts as moderator during the live link, such that the trainees and the other tutors put any questions they may have during the operation to the moderator, who chooses the best moment to put them to the surgeon operating at the other site. This means that the audio link in the receive site is confined to the podium from which the moderator conducts the class. It also means that the tutors and trainees can chat and clarify queries within the training room, without disturbing the operating surgeon.

1.9 In the operating theatre, the room camera is usually controlled by the theatre nurse. The endoscopic camera is, of course, controlled by the operating surgeon. During most of the operation, both pictures are relevant to the trainee, one showing what the surgeon is doing in the operating room, and the other showing what the instruments are doing in the patient's body. The system allows for one picture to be set inside the other, and for the position of the smaller picture to be moved around so as not to obscure the larger picture.

1.10 The Master Control Room within the College is administered by resident staff who manage the live links as well as the other facilities. These other facilities include:

- an edit suite, containing an edit control board that enables all the machines (video-tape players and recorders) to be controlled in synchronised operation and enables mixing and special effects (real-time moves such as dissolve, picture-in-picture, wipes and windows, as well as overlays for graphics, captions and annotations)
- a graphics workstation, which has high quality 'text and draw' capability, in addition to a media exchange facility for importing images from tape, rostrum camera, scanner, Photo-CD, live video, laser disk store or still-frame digital camera
- a still-frame store, which holds 72,000 frames on disk, individually numbered and dial-able instantly, even from the teaching rooms.

Set-up costs

1.11 The hardware and installation costs were *c.* £150k while the set-up costs for the fibre-optic link, including line rental for 5 years, was £55k. The Mercury switchband link cost £2,000 to install plus £2,000pa rental plus core charges.

Description of the teaching

1.12 Courses using live links might last 1 or 2 days. The live links are never used in isolation but form part of workshop-based courses that use hands-on skill-based workstations with simulation tools, videos, tutorials, discussions and other techniques. The live-link transmission of one or more operations often occurs on the morning of the second day if it is a 2-day course. The length of a live-link transmission varies but it is generally planned to tend towards a maximum of 30 minutes per link. This is sometimes exceeded. Several links may be used per course

but one or two is standard. Overall, the use of the live link may form between 1 and 4 hours of a 2-day course.

1.13 The live-links courses (excluding large-audience Master Classes) have from seven to 16 trainees, ranging anywhere from novices to experienced surgeons interested in specialist updating or new techniques.

1.14 The tutors, usually around four in number, provide tuition free of charge and regard it largely as professional development for themselves. Surgical techniques vary considerably even amongst experts, and discussion amongst the tutors is a valuable part of the course and one of the attractions for tutors to give up their time to attend.

1.15 Most, though not all, of the operations carried out over the live links have involved endoscopic techniques. Therefore, in addition to the camera in the operating theatre, there is also a camera in the instrument penetrating the patient's body. The image from this camera is the same for both the operating surgeon and the classroom at a distance.

The Royal College of Surgeons of England

1.16 The Royal College of Surgeons of England, located in Lincoln's Inn Fields, London, is the professional standard setting and examination body for surgery in England. It is also an educational provider in surgery for trainees and for established surgeons. Its members (attained through examination) are both national and international. The College has a specialist education department. It has a dedicated, but small, infrastructure for the development and use of information technology in training and educating surgeons. It has been uniquely successful amongst all Royal Medical Colleges in acquiring funding for IT development.

1.17 Information technology is, perhaps, especially appropriate for surgical specialities that have a high visual and practical skills component.

1.18 The Royal College has 5550 active members in the UK and 1800 abroad. There are 1804 higher surgical trainees (Specialist Registrars) in the UK registered with the College. These are in eight surgical subspecialties. There are also 4000–5000 junior doctors in basic surgical training as senior house officers.

Evaluation

Project set up, management and training

1.19 Tutors for the live-links courses are practising consultant surgeons with an interest in teaching. They undertake such teaching on an *ad hoc*, unpaid basis.

1.20 Live-links tutors, moderators and the operating surgeons have no specific training for the educational task other than a short briefing session. The technical side is run entirely by the technical College staff who were originally trained by Video South who installed the Codec. The tutors and moderators do not need to have any technical skill to operate the system.

1.21 The evaluation shows that such rudimentary training does not seem to have any deleterious effect on the use of the system – these people are, after all, highly experienced teachers in their own right and it could be said that the participants are highly skilled learners. However, the College does believe that there is a need for training and this will be put in place in due course to cover tactics with dealing with delays in getting the system 'on air', eliciting and rephrasing questions, becoming familiar with being heard by an entire operating theatre of varied staff, and communication skills for the operating surgeon.

1.22 The College also employs an Educational Resources Co-ordinator with a team of three audio-visual technicians, one of whom is fully trained while the other two are in training. Each course has a secretary.

1.23 Policy on use of the technology is in the overall control of the College Education Board, which is made up of senior surgeon members of the College.

1.24 The process of setting up any one live-links event involves the College approaching one of the linked hospitals to negotiate a date, time and staff (convenor and operating surgeon). Occasionally, a consultant will operate in a hospital other than his own to use the live links. The College drives the organisation and administration.

1.25 The organisation between College and hospital tends to be administration to administration and technician to technician. Hospitals service their own equipment. They themselves can use it for video conferencing or undergraduate teaching and other purposes as they wish. The College awards a fee for the live-links session to the operating hospital, e.g. £250 for a 2-hour session. The main user of the live-links technology is the Minimal Access Therapy Training Unit of the College.

Cross-institutional links

1.26 Although subsequently there has been a similar project set up in the equivalent Scottish College, there are no institutional links between the two. Neither are there institutional links with any other provider. The only links made are with the clinical partners in the project (hospitals in Guildford, Leicester, Liverpool and central London, with a fibre-optic link to a hospital in East London).

Content and uptake of courses

1.27 The following table presents the available approximate data concerning the content and uptake of courses.

Live-links courses since July 1994

Course	No. run	Partici-pants	Average no. of partici-pants per course	No. of days per course	Total no. of course days	Tutor days
Basic laparoscopic skills	11	131	12	2	22	84
Laparoscopic cholecystectomy	16	146	9	2	32	120
Laparoscopic fundoplication	3	19	6	2	6	31
Hernia	1	8	8	2	2	11
Laparoscopic rectopexy	1	8	8	2	2	11
Electrosurgery	6	44	7	1	6	24
Suturing	5	50	10	2	10	15
Basic arthroscopic skills	7	101	14	1	7	64
Intermediate arthroscopic skills	2	24	12	2	4	24
Old arthroscopic skills	3	48	16	2	6	47
Transurethral resection of the prostate (TURP)	4	64	16	1	4	33
Endo-sinus surgery	1	12	12	1	1	8
Theatre teams	4	64	16	2	8	41
TOTALS	68	719			110	513
RANGE	1 - 16	8 - 146	7 - 16	1 - 2	1 - 32	8 - 120

Course costs and fees

1.28 Postgraduate medical education courses for trainees are most commonly paid for from a study leave allowance attributed to the trainee by the regional postgraduate dean of medicine. This budget is, however, limited, so on occasions the fee may be found by the trainee's employing NHS Trust, by a special grant or bursary or by the trainee personally. Courses for consultants are paid for either by the employing NHS Trust (most usually), from special grants or subsidies or by the consultant personally. The costing and fee structure of the courses are therefore important issues for both the College and the participants.

1.29 The average costing to run a 2-day course is as follows, although these figures will vary considerably from course to course:

Lecturers' travel and subsistence	£1,000
Catering	£550
Consumables	£500
Room hire	£1,970
Contribution to College	£1,293
Audio visual	£651
TOTAL	£5,864

1.30 The running cost of the 2 megabit link is currently £1.38 + VAT per minute (£41.40 + VAT per half-hour).

1.31 The average course fees, at 1997/98 prices, are as follows:

1 day	£250–£385
2 days	£480–£600

1.32 It can be seen from these figures that the economics of the exercise allow little room for manoeuvre.

Ethico-legal issues

1.33 The issue of to whom the copyright on live-links material belongs is an important one. Until it is resolved, making further use of that material is problematical. Legally, the College holds the copyright, but how this works must be agreed with the hospitals.

1.34 Medico-legal opinion has also been sought on other aspects of the use of live links, for example whether or not the system might be a distraction that could cause a surgical accident; and what would happen in the event of the observers seeing something in the operation that is not going as it should when the operating surgeon has not noticed this. The operating hospital deals with issues of patient consent, anonymity and confidentiality. Staff also have confidentiality clauses in their contracts.

1.35 The actual lines are as secure as any telephone line and physical security of recorded material is ensured in a designated area of the College.

Part One: Investigation of current courses

Technical functioning

1.36 Nothing but the highest praise can be given to the technical functioning of the system. Apart from a short loss of audio during the early part of one session, the sound has been perfectly audible throughout. The video has been almost completely reliable, and aside from suggesting to the theatre nurse on one occasion to move the camera onto some support equipment, and a suggestion from one of the tutors to change the position of the picture-in-picture so that it was not obscuring the surgeon's activities, there were no references to the technology at all during any of the live-links observed.

1.37 The College administration reports that sound quality from the operating theatre sometimes presents echoes and other extraneous sounds. There is a need to tune the system and occasionally there is not the technical support at the hospital site to sort out the problems at the time. However, the simple precaution of redialling can solve the problem. In the past, there have been some teething problems of establishing connections and of picture quality. The latter were usually attributable to camera-handling technique.

1.38 In the hospitals, the A-V installer and the Codec installer train the technicians, some of whom are operating theatre staff rather than A-V technicians. The College can offer advice and information.

1.39 The College has established a fail-safe system of pre-testing to establish the link at a low bandwidth first. This is established at least 15 minutes before the scheduled transmission starts. If there ever were to be a complete failure, it is possible to fall back on video material.

Equipment maintenance and the commercial companies

1.40 A live-links maintenance contract is currently being negotiated for Codec and A-V equipment. Interim support is offered by the provider. However, the relationship with commercial companies is somewhat uneasy.

1.41 For the College, it is regrettable that the communications companies, BT and Mercury, have seemingly been unable to provide full customer support and liaison.

1.42 Difficulties have been experienced in finding an account manager and any technical advice from the main (fibre-optic) service of BT. It would appear that as the service does not fall into a specific departmental category, it is 'left in the cold'.

1.43 Mercury have supported the College for the most part in establishing the actual services. Relationships have, however, been strained over determining a clear charging strategy that all parties can rely upon. The issue of call charges remains unresolved and has become a major impediment to any significant developments for other users.

1.44 Neither company seems to the College inclined towards research and development of the communications systems, each wishing to receive assurances of a market prior to any investment, especially for multipointing or international focuses.

International links

1.45 The College hopes to establish international educational conference links as a first step towards establishing live links, but this has, so far, met with some difficulties. All international work goes through BT, although BT does not yet have fully functioning links with all other countries. It has proved easier to dial out than to dial in. Low level links have been established with Spain, Norway and Hamburg despite difficulties in finding assistance within BT. The College has itself undertaken some research and development work to establish even this link.

1.46 However, international 2Mb potential requires further research for the international links and this is not forthcoming.

Trainee reactions

1.47 The view of all of the trainees interviewed about the value of the live links was extremely positive. All of them felt that the opportunity to observe an operation in the relaxed atmosphere of the training room was far more useful for learning new procedures than standing on one's feet for 2 hours assisting by the side of the surgeon. Furthermore, the view at-a-distance was actually better than the view in the operating theatre. Finally, the educational potential of the session was very much enhanced by the facility for interactive questioning of the operating surgeon, and the follow-up discussion with tutors.

1.48 Trainees are used to learning in groups and individually, and this particular aspect of the sessions did not give rise to comment. There were no reports either of the operating surgeon being put off by the presence of the camera or the live link. Again, surgeons are used to operating in a theatre where there is always an 'audience' of some type at any operation. These two facts make the live-links set up fit in with the existing educational and practice culture of surgery.

1.49 What trainees were looking for in observing other surgeons was how they handled problems. In fact, there was an unspoken hope in all those watching that complications would arise during the operation, so that everyone could see how the expert would react to overcome the problem.

1.50 The surgeons from abroad, who attended the one-off Master Class, were very enthusiastic about the use of live links for professional updating, for learning new techniques and for finding out about operations that they might never perform themselves but might want to recommend to patients. Participants at this event ranged from those who would go back to their own hospital and perform the new technique they had just witnessed, to those who were learning endoscopic techniques and would one day perform such operations, and finally to those whose hospitals did not have endoscopic equipment but who wanted to be aware of what was involved in order to provide the best advice to their patients. One surgeon from Denmark said the live-links system was excellent – the only problem was the cost of it!

1.51 Trainees felt that observing live links was useful at all stages of their training, particularly because of current moves to compress higher surgical training from anything up to 10 years to about 6 years.

1.52 The question of whether trainees would benefit from having a video of the live operation to review later received contradictory responses. Some were enthusiastic; others said that the value was in the audio interactions.

1.53 It was observed during the live links that many of the trainees did not put questions to the moderator for the surgeon to answer. During interviews, when those trainees

said that they valued the interaction with the surgeon, it was pointed out that they had not availed themselves of this opportunity. They were quite adamant that their questions had been asked by other trainees, and particularly by the tutors.

1.54 The trainees were asked to compare the value of the live links with videos of similar operations that were shown as part of the course. The answer was that both are valuable, but the videos were edited, 'perfect' versions with many of the details (e.g. of setting up), and certainly any complications left out. The live transmissions were simply a different learning experience – much more about how things are done in practice.

Tutor comments

1.55 Most tutors felt that the value of the live transmissions in the training process of surgeons was not that they substituted for learning through assisting in the operating theatre, but that they speeded up the learning process as a whole. This is the central question that arose and that is followed up in the next part of the evaluation. One tutor commented after the session:

There can be little doubt that this was worth any 10 lectures to these people.

1.56 However, another tutor felt that the future of surgical training was with interactive CD-ROMs, which can offer simulations of surgical operations, the ability to offer choices of action to the learner and to observe the consequences of those choices. They can also offer training in anatomy by moving 3-D images.

1.57 The tutors questioned were less sure about the value of observing live operations at all stages of training. Most felt that surgeons already quite experienced in the relevant techniques were the prime beneficiaries; in other words, that the technique is useful for developing and refining and acquired skill, rather than for acquiring it in the first place.

1.58 The role of the moderator of the live links was the subject of some enquiry. There was general agreement that it was ideal when the moderator knew and had worked with the surgeon performing the operation. Questioning of the surgeon's actions and approaches could then be very collegial and non-threatening. One moderator commented that there was a 'gladiatorial element' to the job, and the skill of the moderator in handling the questions, comments and discussion amongst the group in the room, and fielding this to the operating surgeon, accounted for much of the success of the event as a learning experience.

1.59 Similarly the personality of the operating surgeon – openness to being questioned, ability to work under considerable scrutiny and ease in creating a relaxed atmosphere – clearly contributed to the event as much as general expertise and experience in carrying out the particular operation. Surgeons do generally work under the gaze of others assisting at the operation or learning from it and the College selected for live-links sessions only those very experienced surgeons who were happy to operate under the extended gaze of the live links.

1.60 The tutors were asked about the value of observing operations not involving keyhole surgery. (The appropriateness of keyhole surgery to live transmissions is that the camera entering the patient's body not only gives an excellent picture at the remote site, but it gives *exactly the same picture* as that of the surgeon carrying out the operation.) There was a difference of opinion about extending the use of live links into other areas of surgical procedure. Firstly, this would require an overhead camera and better lighting, so that remote sites could see what is happening. Secondly, a professional cameraman would be required, rather than expecting the theatre nurse to manage the increased complexity that would ensue. A number of

tutors were not overly enthusiastic about this prospect. Others (and also some trainees) would welcome seeing its use extended considerably.

Management perspectives

1.61 Whilst the technology allows the College to record all incoming material and to edit the resulting video tape for later use, in practice the current staff are so busy meeting existing demands they have little time for working with the material generated from live links. The production of CD-ROMs, integrating clips from the live links, as well as graphics and other interactive exercises, is an obvious use of the high quality equipment available. This is one area they wish to expand.

1.62 Designing and preparing the materials for the courses in which the live links are embedded is a very time-consuming activity for the College. One of the things the College would like to provide is a set of guidelines for tutors, e.g. for moderators handling the live transmissions, and for surgeons carrying out operations.

1.63 It is difficult to find new uses of the equipment in the teaching rooms (other than by preparing and offering a wider range of courses) as the links here are only one way at the moment, and only into operating theatres in specific hospitals. However, the large lecture room has possibilities for scaling up the use of the system. Initial interviewing has provided positive feedback so far, but the main event held during the period of this study only resulted in 33 applicants (in addition to the 10 trainees on the 2-day course). As the lecture theatre seats 300, this represents significant under-usage.

1.64 Another area of possible expansion is to increase the number of hospitals joining the network. Given current lack of funds for expansion and the necessary time it takes to have a new system settle down and reach its own level and pattern of use, this possible area of expansion is one that, quite rightly, has not yet been addressed. It is not an obvious limiting factor at the current time.

1.65 The question was discussed as to whether the number of 'appropriate' tutors, moderators and surgeons able to perform under remote observation was large enough to consider significant expansion of the use of live links. This was hard to assess, but did not seem to be a problem at this stage.

Pedagogical considerations

1.66 One of the most interesting pedagogical issues to arise from the use of live links was whether trainees could be learning 'bad habits' by observing surgeons at work. An instance arose during one transmission in which the surgeon performed certain things differently from the standard procedures taught during the course. This was not a problem for the very experienced trainees on this particular course and the alternative procedures were aired during discussion. Nevertheless, the management staff were concerned about the power of the visual image to form the model that is unconsciously copied.

1.67 Related to the concerns expressed by the College is the fact that at no time during any of the live links did the evaluators observe trainees taking notes. Clearly the learning taking place was not a question of listing details, points to remember and techniques to try. The learning was visual.

The College view of the gains

1.68 The College has experienced greatly increased interest in and enthusiasm for information technologies for surgical education. Educational technologies have raised the profile of the College as an educational leader and provider. There is an

increased depth and stability in course development to which the live-links programme has contributed.

1.69 Courses seem now to be better rounded because of the inclusion of direct clinical material, obviating the need for disruptive hospital visits. There is now the potential for a resource bank of recorded material. Whether the copyright belongs to the College or the operating hospital remains to be resolved, and time and resources are not readily available.

1.70 None the less, there is satisfaction that an effective set of teaching programmes with a high ratio of teachers to learners has been established, emphasising skill development and building on the educational and professional culture of surgery.

1.71 Further benefits are:

- increased potential for the involvement of hospitals with the College
- income generation potential
- open communication routes with hospitals
- ability to bring clinical material into the College
- potential to disseminate education and training out from the College to a wider constituency
- positioning as 'market leader' in the field
- potential for opening up educational markets abroad
- attraction of College members to the site that might increase membership.

Part Two: Exploration of live links for skills training and application in surgery

Live links in context

1.72 There was overwhelming agreement among course tutors and participants that what is learned through observation of and discussion with expert surgeons operating via live links has a profound impact on surgical practice. But that impact was not attributed to the live-links experience in isolation. It was seen as the outcome of a range of complementary learning experiences offered in the 1- and 2-day courses run by the College that include:

- lecture/video presentation of the procedure in question
- simulation exercises (related hands-on practice in the laboratory, using appropriate instruments and models)
- tutorial discussion, in plenary and small groups.

1.73 All the participants, bar one, made very favourable judgements of the College's courses. This Registrar speaks for many:

It was an excellent course. I enjoyed it very much, I learned a great deal and I just wish it had been longer.

1.74 The doctor who disagreed was the only person to have attended a 'one-off' live-links session designed for an international audience. He regarded the gathering of some 50+ doctors as so large as to inhibit question-raising and discussion,

particularly among experienced surgeons concerned not to display any lack of knowledge. That aside, the generally very enthusiastic response to the courses was undoubtedly due in large part to the supportive environment and close supervision participants were offered throughout. Usually, the presence of around 10–20 trainees and 5–10 tutors (for example, a 2:1 ratio in most simulation sessions) allowed plenty of opportunity for small-group work. It was also due to the stimulation afforded by the variety of learning methods and media on offer. Each method was seen to make its particular contribution.

- **Lecture/video**. As an introductory plenary session this enabled some overview of the surgical procedure in question and the opportunity for ground-clearing questions and answers.
- **Simulation exercise**. Positioned both before and after the live-link sessions, trainee surgeons found these practical exercises most valuable. They had the opportunity to handle instruments under supervision, to practise hand–eye co-ordination skills using a model, and to seek guidance and advice in a supportive setting. A trainee remarked that:

The exercise after [live links] is more productive: it's easier to spot your mistakes afterwards.

- **Discussion**. In such a supportive setting, the opportunity to ask questions and hear colleagues discuss their ideas was particularly welcome to trainees. As a registrar put it:

There is no opportunity for this on-the-job… You are left on your own a lot of the time. So anything with interaction is good... You can ask questions without seeming stupid.

Discussion that followed the live-links session was 'concrete and well focused'. Then, a tutor took the opportunity to:

...go over the important points, especially if the surgeon has not done as expected. This is very important for safety.

1.75 The fact that the course was conducted away from the participants' workplace and relatively informally was much appreciated, especially by trainees. Others of them remarked:

It was a nice atmosphere. I wasn't pushed for time...no theatre staff breathing down your neck.

Tutors spend time with people. You can ask questions and clarify doubts.

It was informal with lots of communication – much better than straight lectures.

And another concluded:

I feel a lot more confident now. I've recommended [the course] to lots of people. It should be mandatory.

1.76 From the point of view of trainees, then, for best effect live-links sessions should be integrated in a course; or, as a tutor put it:

Seeing plus doing leads to confidence.

1.77 What follows regarding the particular contribution the technology makes to learning should be understood in relationship to these complementary activities, and in the context of successful courses that participants very often praised as focused appropriately, well organised and congenial. The high calibre of the tutors and other staff involved also contributed to their success.

1.78 Three of the tutors interviewed had attended the College's 2-day 'Training the Trainers' course and used the associated handbook. The others had undergone no tutor training.

Distinctive features of live links

1.79 In the context of these courses, live-links sessions were seen to make a 'unique' contribution. Unanimously, interviewees identified *live, simultaneous sound and vision* as what distinguishes this technology and makes it superior to video as a teaching-learning medium, especially as regards endoscopic surgery, which 'is video surgery anyway'. In particular, it offers the following opportunities:

- To experience a 'real-life' procedure ('people bleed, models don't'), including any difficulties that arise, exactly as the performing surgeon sees and does it.
- To see the entire procedure, in unedited form, from pre-operative preparations (e.g. assembly of the instruments) through the procedure itself, step by step: 'you can see where to start, where to go, and where **not** to go'.
- To hear an expert surgeon's account of what precisely is being done and why, while seeing it done, and prediction of the outcomes of other possible courses of action, along with likely post-operative problems.
- To ask questions as they arise and to hear colleagues' queries and the surgeon's replies and explanations. All those who did not themselves ask questions maintained that the questions that occurred to them were raised by other participants, a tutor or the moderator.
- To participate in and hear discussion of aspects of the procedure among moderator, tutors and participants, as it is carried out.

In all these respects, the live television link was regarded as distinct from and superior to video. The interactive capability of live links means that:

It teaches – you don't just see the procedure.

1.80 Nor do you hear a commentary 'on top' that is 'nothing like as good as the ability to ask questions'. Because the procedure is carried out in 'real time', no unrealistic impression of its ease or length is conveyed; and it was thought particularly valuable to be able to learn from the mistakes surgeons may make as they proceed. None of this is available in edited-video format. Furthermore, live links show current surgical techniques whereas performances on pre-recorded video quickly become out of date.

1.81 While viewing procedures in 'real time' is undoubtedly an advantage of the medium, it is also problematic; some procedures may take as long as 3–4 hours, during which 'some dreary things are going on'. Aside from the possible implications of this for the technology's cost-effectiveness, it was thought to be remediable:

You have control over the sound. You can switch off during a tedious or inessential bit and talk with trainees. Then no time is wasted.

1.82 However, the length of the procedure can cause difficulties in the context of the rest of the course:

Sometimes not enough time is given for the live links and you have to go back to another part of the course. So you miss some of it.

1.83 Nevertheless, live links was regarded by many as:

...the next best thing to being in the theatre.

and by some as superior to that experience:

Unless you are actually scrubbed up and at the table, you can't see what's happening.

You see more than you do when you're assisting.

You can ask questions that you probably wouldn't ask if you were a guest in someone's theatre.

1.84 The technology also allows many more people to view a procedure than otherwise would be able to:

You can move a whole group of surgeons on.

Live links and learning

1.85 All the course participants said they had learned a lot from the live-links sessions. For trainees, this was against a background of increasingly restricted opportunity to gain surgical experience in the hospital. They valued live links because it broadened their experience.

You can't see certain procedures at all in most hospitals (plastic surgery, breast reconstruction, laproscopic surgery).

Different surgeons do things differently, and most surgeons feel every operation is different. So you need to know what the options are.

1.86 They also acquired an understanding in-depth of the particular procedure in question and of related surgical techniques. The performing surgeon's-eye view was their view and, hence, his experience was also theirs (all interviewees had seen a male surgeon at work). As he encountered unexpected difficulties and took steps to overcome them, so they learned from the shared experience, discovering a 'new dimension' of the procedure or acquiring a 'different perspective' on it. Consultants reported similar learning gains only when the procedure in question was new to them.

1.87 For trainees far more than consultants, the upshot was a feeling of greatly increased confidence. Trainees themselves saw this as a highly significant outcome. Even when the surgeon's handling of the procedure delivered no surprises, it reassured them to find their own approach and practices 'reinforced'.

1.88 Because trainees valued the broadening and deepening of their experience through live links, and the confidence this inspired, they thought it was important to see surgical procedures in their entirety. However, some course tutors and consultants denied the need for this: from their perspective of greater knowledge, a focus on 'the good bits' or 'what's important in the operation' was preferred. For

consultants, the major outcome was learning 'tricks of the trade' to deal with unexpected occurrences:

Things always go wrong. It's fun and also reassuring to see how to get out of it.

1.89 It mattered very much to all participants that they saw an 'expert' surgeon at work.

You learn better when taught by a very senior, highly skilled person in the field.

I took away an idea of current best practice by experts.

1.90 However, in a few cases, two live-links procedures were included in the course, one performed by an expert and the other by a trainee surgeon. The latter's performance was also found helpful by trainee colleagues because:

You see the mistakes – the kind I might make myself.

1.91 Overall, only one or two tutors were disturbed by surgeons' mistakes or departures from recommended practice, with other tutors and the participants regarding these as the most important kind of learning.

Interaction

1.92 Undoubtedly, the feature of the live-links technology that most contributes to learning is interaction – between the participants and the performing surgeon, through the office of the moderator. All interviewees placed the greatest value on being able to clear up any confusions or doubts by putting questions to the surgeon at appropriate moments, and hearing some explanation of his actions. In this connection, the moderator's role was regarded as essential, from a practical point of view, as an experienced surgeon able to pick the right moment to put questions to the operator; and also as potentially very fruitful, in 'pointing out when the operator did things wrong' and 'sparking off interesting discussions':

They should be asking the appropriate questions; the ones that need to be asked.

1.93 Trainees also valued discussion between the moderator and tutors present, as they pointed up details and offered explanations of what was happening.

Type of learning

1.94 It is clear that learning from live television links is not a question of acquiring skills, for which it was agreed that hands-on practice is needed, nor of memorising or taking detailed notes for future reference. Rather, the learning is 'immediate', experiential and holistic. Centrally it involves apprehension; the grasping of ideas, shifting of perspectives and increasing understanding that results from seeing a complex activity performed in all its complexity, and from interaction with others' perceptions and understandings.

1.95 Learning any aspect of medicine is very much of this order. It is experientially based with a large component of analysing that experience and using it to make judgements about future cases. The live-links teaching has tapped into this process and has probably enhanced the reflective and integrative component. Although skills can only be learnt through practical experience, the appropriate use of these skills, the prediction of their effect, their application in problematical circumstances and their modification for given situations can obviously be learned through the live-

links approach. This is a considerable enhancement of the professional learning process.

Live links and surgical training

1.96 The contribution live television links may make towards training surgeons must be understood in the context of the current situation within surgical training as a whole. All the trainee surgeons, and most consultants and course tutors, believed that there is now less time available for training on-the-job in hospitals.

1.97 The main reasons offered included cuts in resource for hospitals, the effects of commercialisation and of recent changes to the organisation of higher specialist training that has decreased the overall exposure of trainees to clinical work:

There are so few beds that they are cutting down on operations. We can't see or do operations as often now. The Trusts need to spend more time and money training people.

Training is cut down, the operative load is down because of cuts in resources and consultants do most of the advanced surgery...most of all, we need to do more operating. We don't get enough practice.

1.98 A consultant put similar anxieties even more forcefully:

The reduction in junior doctor hours and years of training is a fatal combination, leading to poor quality consultants and less experienced specialists.

1.99 Against that background, there was general agreement that surgical training needs to be conducted more formally, in more structured ways:

Courses are important. It's easier to train on-the-job if you have done a course.

[Trainees] need a half-day for training. We need teaching programmes so juniors have a half-day off for training. This needs to be done fairly formally – the College has to get into training in the hospital itself.

1.100 As this last remark suggests, the College has an important role to play in providing more structured training, through its courses and by introducing teaching methods such as live links:

[Recent changes in the organisation of postgraduate training in medicine] anticipated more direct teaching and formal training, not just an apprenticeship. The College is doing the right things.

1.101 In this context, use of live-links technology was widely regarded as 'reinforcing' or 'enhancing' training, making it 'more effective' and of 'higher quality'. Of major concern to consultants and tutors was what it contributes towards safety:

It reinforces safe ways of operating. You can question if something is not done properly and use it to advantage.

Effect on overall training time

1.102 No interviewee believed that live links could reduce the time needed for training ('it introduces another step...'). And all were adamant that it could never replace nor substitute for actually performing operations:

You can't replace hands-on, but lots of preliminary training needs to be done. Surgeons should be trained like pilots, in simulators. You don't send a pilot off in a million pound jet straight away.

1.103 In this connection, a tutor described live links as offering an 'accelerated apprenticeship'. It was also argued that it is helpful towards career development:

You often have to choose a specialisation without having seen some [types of surgery]. You can at least see procedures on live links that might help you decide on a specialisation.

Live links and the stage of training

1.104 As regards the stage in training when it is particularly helpful to see procedures via live-links, the consensus among interviewees was that it is most valuable to higher surgical trainees, 'once you've had basic surgical training'. It was argued that some prior knowledge is needed (of theory, anatomy and instrumentation) in order to understand what is going on, and/or that greatest benefit accrues after the trainee has assisted in the procedure a few times:

You need to know a bit to ask particular questions. The more experienced go for the nuances.

It's better if you've done the operation yourself because you know where the problem areas are. When you've assisted you appreciate the complications. You're looking for different things.

1.105 However, a few interviewees in each category thought that everybody has something to learn from live links, from Senior House Officers (SHOs) to the most senior of surgeons:

The earlier the better. It develops creativity in upcoming surgeons if they are exposed early on.

Consultants need to learn new technology. It's especially good for consultants. Juniors can be trained by them, but there's no-one to train consultants in new procedures.

1.106 Consultants themselves confirmed that learning new technologies, and new or pioneering procedures was what they sought in live links.

1.107 Trainees, however, were divided between those who wanted to see fairly common operations and those who were interested in specialised or fairly rare procedures. One of the tutors mapped out the following programme:

- keyhole surgery: everyone, from SHO on
- complex surgery: registrar/senior registrar
- pioneering procedures: consultants.

Conclusion: the impact of live links on surgical practice

1.108 It is clear from the foregoing account that the knowledge and understanding they reported as having acquired by this means is indeed carried over into surgical practice.

1.109 All the consultants interviewed said they had carried out the procedure seen through live links subsequent to that experience, and that they had applied what they learned to their conduct of the operation. This was also true of three of the trainee surgeons:

Yes, it changes your practice. It's an extension of the apprenticeship model.

1.110 In the interim, the remaining trainees had not had the opportunity to conduct or assist in the procedure they saw, but all of them said they will apply what they learned when the opportunity arises:

Yes, I learned the kind of thing I will put into practice.

I will feel much more confident as I move on to more complex operations.

1.111 Finally, all five tutors of the courses confirmed these conclusions; they were 'convinced it does happen'.

Part Three: Extension of live-links technology and applications

Options for expansion

1.112 The live-links programme is built upon a very large capital investment for equipment and infrastructure. The Royal College is faced with increasing pressure to maximise the use of the system as well as considerable interest from other hospital sites around the country to join the network. However, the main question concerns whether and how the College itself will expand.

1.113 In the telephone interviews, the surgeons' judgements regarding these issues were consistent with their views about the nature of the contribution made by the technology and also its educational value, especially as regards the perceived importance of interactivity for learning.

Live links on video?

1.114 One of the possibilities mooted was to record live-links sessions and prepare video tapes that might then be purchased by hospitals and/or by any surgeon wishing to see a particular procedure. The majority of the course participants interviewed were in favour of the idea:

They should be part of the course that you take away with you – and also for purchase by anyone, especially if they are cheap.

1.115 However, these interviewees were divided on the question of whether such videos should be edited or should show procedures in their entirety.

1.116 Those who favoured edited videos were mindful of the length of some of the procedures shown on live links, and wanted the 'tedious parts' to be removed. A trainee thought:

A 'video nasty' would be helpful – common problems met in a procedure.

1.117 But some of them, along with those who preferred entire procedures to be shown, argued that it is 'essential' or 'vital' that the sound track faithfully records the questions put to the performing surgeon and his answers to them; 'people need to hear the explanations'. Those who favoured a recording of the complete procedure were convinced that, through editing, the performance would be 'cleaned up':

They edit out the problems. But that's precisely what you need to see.

1.118 Some participants and most course tutors were opposed to the idea of video recording live links on the grounds that 'it's no better than ordinary video because it is not interactive'. They thought it essential for surgeons to experience live links in the setting of a course, involving face-to-face discussion and exchange of ideas. Also, certain ethical/legal questions were raised:

No [to video recordings], unless the consent of the patient is obtained. If so, would the video be sold or given away? Who gets the royalties?

Live links around the UK?

1.119 Another possibility is to extend current use of live links by equipping more hospital sites to participate. This would contribute to the cost-effectiveness of the scheme by increasing the number of surgeons able to benefit from each procedure carried out. Since surgeons might receive that benefit nearer to home, it would also reduce the costs of training to the hospitals, in terms of doctors' time, travel and subsistence.

1.120 Trainee surgeons and course tutors were most enthusiastic about this possibility:

Brilliant. Definitely. Lots of people would attend [locally]. The College's courses are very expensive.

Young doctors want to be taught properly, by experts.

Lots of training could be done in the hospitals, in courses directed by the College.

1.121 Most of these interviewees assumed that procedures would be seen in the context of a regulated course. Those who dissented feared either that participating sites would be offered 'one-off' live-links sessions, or that they would be linked up in 'receive-only' mode. The cost involved was also queried:

But is it cost-effective? Or would it be cheaper to concentrate resources in one centre – the College?

1.122 A number of participants stressed the especial advantage of such an extension of live links to those in the regions and to trainees, though the possible benefit to more senior 'dinosaur' surgeons was also remarked upon. Once again, the caveat was that those on the receiving end of the transmission should always be able to ask questions of the performing surgeon and hear the replies.

1.123 A further consideration here, at least in the short term, is the robustness of the technology. While the great majority of interviewees had experienced no difficulties with either sound or vision during transmission, a few had. These doctors had all participated at 'satellite' sites (for example in Guildford), which rely upon a telephone rather than cable connection. They questioned whether the telephone system is reliable enough to warrant extension of the system at present.

Different kinds of procedure via live links?

1.124 A further possibility is to increase the range of operations carried out via live links, for example regularly transmitting open as well as keyhole surgical procedures.

1.125 Almost all of those interviewed approved of this idea – 'yes, by famous surgeons' - even though most were aware of the greater technical challenge involved:

Camera work is much more difficult, but we should not be deterred by the technical difficulties.

1.126 However, one or two in each category, and proportionally more tutors than others, were not in favour because:

> *You don't get the same view as the [operating] surgeon. You need to see direct – what the surgeon sees.*

1.127 On those grounds, it was suggested that open surgery should be included 'only if it's a rare procedure'.

New audiences for live television links?

1.128 The possibility of maximising the use of the technology by extending its benefits to other occupational groups was also mooted; for example, to nurses, general practitioners (GPs), doctors other than surgeons, paramedical staff and hospital administrators.

1.129 It was felt that nurses, in particular, would benefit because:

> *Many of them are very vague about what happens in theatre – they could explain the procedure to patients and talk to them about it afterwards.*

1.130 Several singled out theatre nurses:

> *They are part of the operating team...so they know what the surgeon is doing and can help at every stage.*

1.131 Similarly, such increased understanding of the operations patients would ultimately undergo was thought to be of benefit to paramedical staff.

1.132 As regards GPs:

> *They now do day surgery – minor operations such as vasectomy, skin lesions and so on – but they don't have time to attend hospitals to learn.*
>
> *When they were dealing with a patient they could answer their questions...useful for trouble shooting.*

1.133 A number of participants thought that doctors in other disciplines would also benefit from appropriate uses of the technology; citing cardiology, intensive care, neurosurgery, physiotherapy and interventional radiology. It was also argued that medical students would benefit because 'they wouldn't have to waste time in theatre – they could see it on live links'.

1.134 Hardly anyone thought that hospital administrators would be interested in seeing surgical procedures of any kind, or derive much benefit from it. Indeed, one surgeon was worried by the idea:

> *If mistakes in surgery are recorded, could this be used in legal action against the surgeon?*

1.135 On the other hand, it was argued that:

> *[Managers] don't realise the complications that can occur. They might appreciate what goes on better.*

1.136 Finally, a few interviewees thought that the technology was 'mainly for surgeons':

Very limited application [beyond surgery]. This is not a high priority for the College.

Other options under consideration

1.137 The following options are under consideration:

- investing in a broadband broadcast system to make live operations available in a receive-only mode to a wide spectrum of sites around the country
- expanding the present system to a multipoint network, so that every site could both originate and receive teaching, possibly simultaneously
- remaining with the current one-way system, but enlarge the number of participating hospitals.

Broadcasting

1.138 The three expansion possibilities rest on the issue of what additional audiences the live-links operations might address. The interviews indicate that the interactivity was an important aspect of the live links, even though some did not personally take advantage of it. But it had to be there so that someone could put the question that each trainee wished to put. This might indicate that the broadcast option is not entirely a satisfactory development.

1.139 If pursued, however, the idea of expanding into broadcast mode would extend the College's use of the system from a small but significant part of a 2-day training course, into a much broader awareness-raising, updating arena, targeted at the wider medical profession and at a range of other professions allied to medicine. Some of the people attending the one-off Master Class were from these categories. The installation of a broadcast system to many more sites would mean that such people would not need to travel to London, but could attend a live-links operation from their own hospital. If this were co-ordinated with the complementary teaching and learning methods, this might be successful. As broadcast alone, indications would be that this is a risky development.

1.140 There have been previous experiences of educational broadcasts for postgraduate and continuing medical education, the Medical Television Network being one of the most recent. In general, none of these has gathered or retained an audience of any size. Lack of uptake of the system is a consistent factor that needs to be taken seriously. The explanations are both to do with the professional culture of medicine as well as with the practicalities of a clinician's daily life:

- Broadcast material has been delivered into the postgraduate medical education centres of hospitals at lunchtimes or some other time when it is assumed that clinicians will be free. But isolating senior doctors from their clinical responsibilities whilst inside the hospital is often an uncertain undertaking. It is slightly more feasible for junior doctors.
- Broadcast material implies a common interest among a wide audience in a given topic. But different clinicians have different interests and are at different levels in relation to that interest. A large audience is therefore often not to be gathered that easily. This might to make broadcasting uneconomic.
- Although trainees do have some time dedicated to training away from the clinical arena, this tends to be organised locally at times that fit in with the operating or other schedules of the hospital. Having all trainees leave the wards or the theatres at the same time is an organisational challenge when they have clinical duties to perform, although this is happening to some degree within current structured

training programmes. There might be some future in presenting short 'membership courses' in this way to prepare trainees for examinations, perhaps in support of the College open learning course.

- Learning medicine at postgraduate level tends to be in the nature of a very organised and high level apprenticeship, based on supported experiential learning. Other types of learning are focused, for example preparing for an examination or learning a specific technique, or are marginal. The focused teaching could well benefit from broadcast material.

- Medicine does not have an organisational infrastructure and dedicated teaching time for education at postgraduate level, even though it might have some dedicated learning time. The teachers are consultants who find the time to teach, whose contracts state that they have 'responsibility for the education and training of their juniors' but do not specify when that responsibility is to be discharged or for how long. The use of broadcast material would require some local organisation, planning and support.

1.141 Broadcast material, say for recording and later use, may well be a possibility, although this had also been tried in some specialities to no great effect. The way in which the College has chosen to set up and use their system derives from the culture and the opportunities for learning which their profession has. There might have to be some cultural and organisational changes if very different uses were to be promoted and widely used.

Multipointing

1.142 Introducing a multipoint network would change the focus of the system in many ways. At the moment, the College in London acts as the hub, originating the courses to which the hospitals connect like spokes on a wheel. With a multiway system, the College would lose its central position, as any site could set up a link to another site without involving the College. The College might not be the only originator of training courses. The system could also be used for lectures, meetings and all of the myriad uses of a broadband video-conferencing system. Obviously this kind of use would extend the potential audiences quite markedly.

1.143 The value of a multipoint system from the College's point of view is that it could expand its training sites to bring in potential trainees situated in other hospitals. Experience with other multipoint systems shows that about five to six separate sites is the maximum number of simultaneous users possible without diluting the effectiveness of the interaction. In addition, it could increase the value of the live-links element of any training course by linking with several operating theatres and switching between operations to show 'highlights' rather than one single operation.

Sticking with the status quo

1.144 The third option is to keep the system as it is and to concentrate on good use within the present model. Additional sites could be added to the network on the current one-way system and additional courses could be added to the training programme, such that the facilities were used to the maximum. This would probably involve designing courses around open surgical procedures, rather than relying solely on the keyhole techniques used to date. While this option requires a much lower equipment investment, it would be very demanding on College staff.

1.145 This third option has the lowest risk factors associated with it. However, in a technology-driven age where change is the norm, the *status quo* can often be the most dangerous position to adopt. It is important to the College that it maintains its leading-edge image, and to do this it must continue to innovate with available technologies.

1.146 The College has proved that it can use the current technology successfully and that it can design and run pedagogically sound training courses around the technology. So far, these uses have been based on a very 'hands-on' approach, an enviable trainer/trainee ratio and high levels of interactivity. The options discussed here, on the whole, involve a movement away from this approach to larger numbers, less interactivity, and shorter training events. Concerns about quality, costs and take-up are inevitable. Some market research is required.

1.147 However, the College should bear in mind that as the market leader, it is in a position to 'create the future' not just respond to it. The technology of live -links is clearly popular – not only with trainees, but also with hospitals 'queuing' to join the network. The training need has never been stronger, as other forms of training are being curtailed and surgical procedures are expanding in number. With careful analysis of the training scene, the College is in the best possible position to be pro-active in creating new markets for the uptake of its training programmes.

Integration with other technologies

1.148 The College is already considering the use of other telecommunications technologies as a means of expanding and enhancing its training programme. Members of the College have visited the Open University to look at a range of technologies for delivering on-line training. At the broadband level are various forms of virtual reality, such as the Stadium facility for delivering on-line lectures and real-time seminars. This technology uses RealAudio and Web-based pages for lecture notes, diagrams and simulations. The event can be accessed in real time, and with a broadband connection the trainees can respond with audio questions. A record of the event can be stored on the Web site for subsequent trainees to access, thus drawing on the advantages of both synchronous and asynchronous learning.

1.149 The Virtual Microscope is another example of the kind of teaching material now available for training at a distance. This system (http://kmi.open.ac.uk) was originally designed for disabled students, unable to use a microscope. It has now been developed for the Web, both in individual mode and more recently for collaborative access from multiple sites.

1.150 Computer conferencing, whether as a proprietary system such as FirstClass, or as an adjunct to the Web, is another technology that the College can see as a useful addition to its teaching profile. Asynchronous text-based discussion has a place alongside broadband technologies, practical work and face-to-face teaching in the on-going training of surgeons.

1.151 Multimedia has obvious applications in surgical training. However, the development cost of high quality multimedia is a well-known barrier to its use in any educational area. The convergence of multimedia technologies onto the Web, along with the facilities for many-to-many communication, make on-line training increasingly attractive to the College.

1.152 Some of these possibilities, and others, were raised in the telephone interviews with course participants and tutors. The majority of course participants, though proportionally fewer tutors, believed that surgical training would and should increasingly rely upon 'high tech' solutions in the future:

This is the way forward. It's happening all over Europe.

It's a number of years off, but the College should go that way.

1.153 Those who disagreed tended to raise the familiar question of the effectiveness of training by these means:

You need a group to talk with face-to-face – to ask questions and challenge each other. We need personal interaction.

or the question of the resources provided for training:

There are very few computers [for this] in hospitals. They are just not available. Trusts do not give money for education.

1.154 A few participants and tutors simply said they did not know enough about the technological possibilities to make a judgement.

1.155 When asked for their views about applications of particular technologies within hospitals, few interviewees felt able to comment. However, the following suggestions emerged.

Virtual reality

1.156 This would be useful for surgeons to carry out simulation exercises:

Surgeons should be trained like pilots, in simulators.

1.157 But the opposite view was put too:

There's nothing tactile; no instruments in your hands.

Web pages

1.158 GPs might access results from pathology by this means.

Computer conferencing

1.159 A consultant argued that:

We should have a half-day for training nationally, then live links could be arranged for that time along with computer conferencing.

Video-conferencing links

1.160 Application of this technology was envisaged for a range of clinical rather than educational uses:

...between hospitals and paramedics at the scene. Doctors can see what will be needed at the hospital and can give instructions to the paramedics.

GPs could have access to a surgeon – send X-rays to an expert.

Applications to surgical training

1.161 The College already has a Web site and could begin to build this up over the next year. The following suggestions could be investigated:

- The Web could be used for market testing by making a short questionnaire available for surfers to fill in about potential courses the College might develop.
- As a support mechanism, the Web could be used for potential trainees to request information and to register for courses.
- A Web-based conferencing system could be chosen to support a course delivered through other technologies (print, face-to-face or live links). For example, a course could be developed that combined a broadcast live-links session with

collaborative work, readings, discussion and a RealAudio lecture, all delivered on the Web.

- The Web could be used to support the assessment of current distance education courses offered by the College. Multiple-choice questions could be designed for the Web, and assignments could be sent to the College as attachments to messages.
- Multimedia materials and video clips that the College already has, could be made available on the Web as part of a course or as a whole course with structured Web pages, exercises, computer-assisted learning (CAL) materials, and text-based discussion.
- On-line discussion could become an integral part of the current live-links training programme by running a follow-up conference as part of the integration of skills and procedures into subsequent clinical practice.
- Text-based discussion and multimedia Web pages will never substitute for hands-on training or for assisting at surgical operations. However, they can provide a useful adjunct to these more costly training modes, and they have the advantage of being time and location independent.