Double vision: an exploration of radiologists’ and general practitioners’ views on using picture archiving and communication systems (PACS)

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Abstract
This article explores the perspectives of two user groups, general practitioners (GPs) and consultant radiologists (CRs), on the rollout of picture archiving and communications systems (PACS) within acute trusts and eventually to primary care as part of the electronic patient record. Qualitative interviews were conducted with 16 CRs and 31 GPs. Analysis was carried out using a grounded theory approach. Radiologists expressed positive views...
about the implementation of PACS in secondary care, but were wary of GPs accessing radiological images. GPs expressed concerns about the added burdens that PACS might bring to primary care, but most felt that sharing images with patients could benefit doctor–patient communication and increase patient satisfaction. This study highlights both impediments and pathways to the implementation of PACS in primary care, and illustrates the importance of regarding PACS as socially embedded and users as culturally disparate.

**Keywords**
general practice, medical informatics, picture archiving and communications systems (PACS), primary care, radiology, sociotechnical aspects of healthcare

**Introduction**

There is growing evidence that the successful implementation of IT in healthcare depends as much on the social, cultural and organizational aspects of change as it does on the technological [1, 2]. There is a tendency toward ‘technocentricity’ in design and dissemination within healthcare practice, whereby the needs and demands of new technology take priority over the social structure necessary to support it [3]. In contrast, a sociotechnical approach considers as central the views of users (and potential or future users) in the development and dissemination of new technology. In such an approach, user participation and user involvement in the design and implementation of innovations are fundamental inputs [4]. An illustrative case in point concerns the importance of considering user groups in the deployment of PACS within the United Kingdom’s National Health Service (NHS). PACS involves the replacement of traditional X-ray film with images in digital electronic format – a technological shift which has widespread impact on radiological services by supporting ‘the storage, distribution, communication, display, and processing of radiographic image data’ [5]. Current and potential advantages of PACS include the centralized storage of images, shorter reporting times due to the reorganization of radiology services, remote access to images and reports, and a reduction in the numbers of lost or misplaced images. In England, such PACS ‘solutions’ are being ‘procured and provided’ by the organization Connecting for Health (CfH), which has overall responsibility for implementing the National Programme for Information Technology (NPfIT), the policy of implementing IT agendas within the NHS. PACS, as part of NPfIT, aims to offer ‘controlled access’ to digital images for all NHS organizations in England, including, eventually, primary care [6]. Feedback from hospital settings suggests that PACS and its associated supporting technologies have been well received and are counted as a success story for NHS CfH. In December 2007, PACS deployment was reported as ‘complete’ by Connecting for Health [7].

What, however, of the plan to ‘roll out’ PACS technology to primary care settings, in particular to GP surgeries? Currently, GPs who refer patients for outpatient radiology procedures typically receive a report from the radiology department, which allows the GP to relay information to his or her patient. Through the EPR, access (‘controlled access’) to images will also be available to GPs. In fact, according to CfH, access to PACS by primary care has already begun; their figures show seven ‘deployments’ of PACS in primary care as of January 2008 (F. Carlisle, CfH, personal communication, 2008). Although the main aim of incorporating images into EPR is efficiency and streamlining of record-keeping, it will also enable sharing of these images with patients. General practitioners (GPs) in England will then have direct access to digital images, prompting our inquiry into how such a development might be regarded by GPs and by consultant radiologists.

We explored the perceptions of two groups of users and potential users of the new system: hospital-based consultant radiologists (CRs) and practice-based GPs in the county of Sussex, southern England. In doing so we examine what Lundberg has called the ‘sociotechnical web’ [8]
as it affects, or is perceived to affect, these two sets of medical practitioners within and beyond the hospital setting. A number of the CRs already had personal experience of PACS usage, while others knew a great deal about PACS in theory but not in practice. In contrast, the GPs knew little or nothing of the system other than the brief and general explanation provided by the interviewer.

**Background**

Both actual and anticipated change in working practice demand more than skill enhancement and technology transfer; attention must be paid as well to the underlying impact on social, cultural and behavioural factors involved. Tellioglu and Wagner [5] analyse the space within which work takes place and how the use of space acts to maintain both contact and boundaries between practitioners. Implementation of PACS necessitates alterations in the spatial and thus the social aspects of work. NPfIT has not always been sensitive to these issues. Hendy at al. [9] interviewed senior staff at four NHS acute trusts concerning implementation of the IT programme, reporting that it was ‘suboptimal’ and that there was overall a sense of low morale. The authors concluded: ‘The sociocultural challenges to implementing the NPfIT are as daunting as the technical and logistical ones. Senior NHS staff feel these have been neglected. We recommend that national programme managers prioritize strategies to improve communication with, and to gain the cooperation of, front line staff.’ Kirshbaum [10] conducted a survey of attitudes toward IT use across a wide spectrum of hospital employees in two NHS hospitals prior to implementing EPR, and found large variation in knowledge and acceptability of planned changes. Thus, an investigation in advance of further implementation of NPfIT components such as PACS in primary care seemed apposite.

In a number of countries PACS is already being used outside the hospital setting to deliver more efficient radiology services (e.g. [11–14]); it is possible that lessons learned elsewhere may be useful for the UK situation. In the US, origin of much of the literature concerning the change to PACS-based digital imaging, primary care physicians already traditionally incorporate film X-rays in their practice of medicine, so that ‘introduction of PACS’ is synonymous with the ‘disappearance of film’. The transition to digital images in the form of PACS, while not straightforward, focuses on implementation of new technology for generating and viewing images. For example, in weighing the benefits of against the obstacles to ‘going filmless’, Naul and Sinclair [15] describe access to PACS as ‘particularly useful for patient education and consultation’, while one of the main disadvantages is a ‘tendency for less interaction among radiologists and other physicians’. Wadley et al. [16] describe a high level of satisfaction with the implementation of a filmless, PACS-centred radiology service in Santa Barbara, California. In the UK, access to digital images in primary care via PACS technology is likely to constitute a grander shift, with the images representing wholly new clinical information in the doctor–patient consultation, as most GPs do not typically view or read radiological images as part of their standard working practice.

In Europe at the start of the new millennium, Norway, Sweden and Austria led the way in terms of PACS preparedness and implementation [17]. Aas [18] conducted interviews amongst PACS users in Norway; respondents reported as disadvantages the splitting of the professional community and the reduction of contact between radiologists and clinicians. Respondents also feared that the effect of further reducing contact between radiologists and patients might result in a shortage of medical students selecting radiology as a specialty. Fridell et al. [19] conducted a longitudinal qualitative study in Sweden and found that implementation of PACS resulted in a form of ‘democratization’ of image interpretation; as non-specialist clinicians acquired the skills to read and interpret X-rays and other radiological images, radiologists responded by becoming more specialized. Harno et al. [12] describe the need for PACS to surmount ‘barriers’ between primary and secondary care in Helsinki. Tually et al. [20] in Australia describe the delivery of radiological images via a
web browser to remote western regions; their report comprises mainly technological issues which were found to be satisfactory by a range of patients and staff questioned.

**Methods**

The study investigated GPs’ and radiologists’ clinical, technical, organizational and sociocultural views on the use of PACS in primary care, by (1) reviewing literature on the implementation of PACS in primary care outside the UK, and (2) conducting qualitative interviews with local CRs and GPs. Interviews were conducted in 2005, before knowledge of or expectations around PACS technology were widespread outside hospital-based, relevant clinical specialties such as radiology.

We gathered a purposive, snowball sample of 16 CRs in the south-east of England and 31 GPs in primary care trusts (PCTs) in East Sussex, aiming to include a variety of practice sizes and a range of career lengths. We randomly selected one doctor within each GP surgery in three PCTs in East Sussex to receive an invitation to participate: Brighton and Hove (n = 52), Eastbourne (n = 23), and Hastings and St Leonards (n = 25). Each selected doctor received a cover letter, an information pack explaining our research (including basic information concerning PACS), a response-plus-consent form, and a postage-paid envelope. Response within Brighton and Hove was greater than in the other two PCTs, so we stopped interviewing when a total of 15 respondents was reached. In the other two localities, the response rate was lower with only 11 immediate positive responses, so we augmented our sample via a ‘snowball’ technique using personal referrals from already-enrolled GPs. The final sample size for Brighton and Hove is 16 GPs in 15 practices, as one interview included two GPs from the same practice (at their request). From Eastbourne and Hastings and St Leonards (combined) a total of 13 GPs participated.

To recruit CRs, we compiled a list of radiologists by contacting the radiology department of each major district general hospital in Surrey and Sussex Strategic Health Authority (n = 11) and then randomly selecting one radiologist within each of them. This yielded eight respondents; again, a snowball technique relying on personal relationships and goodwill amongst the consultants enlarged the sample to reach our target and beyond (by one). Interviews within Brighton or Worthing were conducted face-to-face while those outside the local area were conducted by telephone. To preserve confidentiality we have avoided identifying CRs by their hospital affiliation.

All of the interviews with GPs outside Brighton and Hove involved telephone dialogues which were taped, with explicit consent of the respondents, using a digital hands-free recording device. A proportion of the initial interviews in Brighton and Hove were conducted face-to-face; these were also taped, with consent. All interviews were fully transcribed.

The semi-structured interviews aimed to elucidate the existence of barriers to and support for the potential rollout of PACS technology into general practice. More specifically, we focused on questions about communication between general practice and radiology, current knowledge of and attitudes toward PACS, the (existing or prospective) advantages and disadvantages of PACS for imaging services and for patient care, in terms of both clinical management and clinical outcome. We also asked respondents to anticipate whether and how disseminating images using PACS technology might affect the working practices of CRs and GPs, and the interaction between the two groups.

Following the constant comparative method a thematic analysis was conducted using guidelines suggested by Mays and Pope [21] for achieving rigour in qualitative research. Four of the authors familiarized themselves with the data through reading and rereading the transcripts; when all the data had been reviewed we collectively returned to our notes to identify key issues, concepts and themes and developed a framework in which to proceed with the data analysis. A fifth member of the team drew together the interpretations of the coded data, and independently reviewed the raw data, to produce the final, written analysis.
To triangulate the data we presented a preliminary project report at a local primary care research network conference and at a national meeting of radiologists and general practitioners organized by the Royal Colleges of Radiology and General Practice. Audience response suggested that our findings resonated with attendees’ experience, which helped to confirm the validity of our interpretations.

Names of all respondents have been converted to codes. When quotes from respondents are cited in the text of the article, any identifying details have been omitted or altered.

Results

Characteristics of respondents

The 16 CRs had an average of 14.7 years in practice, ranging from 6 months to 28.5 years. The 31 GPs averaged 18.3 years in practice, ranging from 15 months to 36 years. Practice sizes ranged from two respondents who practised single-handedly, treating approximately 1000 patients each, to nine doctors belonging to practices serving 10,000 to 18,000 patients and employing seven to 11 full-time-equivalent (FTE) GPs. Topics discussed in interviews include the current situation for CRs regarding PACS in secondary care, and GPs’ and CRs’ views on the potential for PACS and service delivery in future.

Organization of PACS in secondary care: current situation

The interviews were conducted in the first half of 2005. At that point, CRs as a group were quite familiar with PACS. Five CRs had experience of using PACS for two or more years in their main NHS hospital, and an additional two CRs had significant experience of PACS in a non-NHS (private hospital) setting. To most GPs, on the other hand, the concept of PACS was a novel one and thus during the course of the interviews there tends to be a shift from unfamiliarity, often manifested in suspicion, toward growing interest and curiosity as to what the system might offer them and their patients.

At the time of interviewing, most of the CRs were based at hospitals that were in the midst of procuring PACS via the NPfIT. One of the hospitals in the study acquired a PACS system privately, in advance of the NPfIT installation, and so had a head start on its use; one of its CRs expressed the opinion that their system was ‘slicker’ than an NHS-provided one. The CR (R7) acknowledged that the private system was costly but compared it (positively) to owning ‘an S-class Mercedes’ rather than a ‘second-hand something-or-other’. Respondent R2, based at a hospital in the midst of installing the NHS-funded PACS, acknowledged that the pot of money available bought only a ‘partial’ system, and would require either topping up from non-trust sources, or continuing to use film alongside the PACS. The majority of radiologists (for exact numbers see Table 1) expressed enthusiasm for PACS in the hospital setting; they had experienced, or were anticipating, increased speed and promptness of reporting patients’ results, reduction in lost or mislaid images, and reduction in amount of time and effort spent in locating existing images. Radiologists where PACS had already gone ‘live’ appreciated the appearance of a filmless hospital, expressing the view that it was cleaner and looked more professional (R7). The patient journey is smoother with PACS: ‘[One of the] major advantages of PACS is that as long as the IT system works, their X-ray films shouldn’t be lost’ (R6).

Concerns, such as they were, revolved around fears that a lack of adequate financial support would prevent the system from fulfilling its potential. Several CRs emphasized to the interviewer that in spite of the ‘slick’ and convenient technology offered by PACS, the need for human agency in the form of more radiologists remained unchanged, and its provision inadequate.
Views on PACS and service delivery at primary care level: radiologists

Regarding the question posed by the interview about the possibility of rolling out PACS access to general practice, CRs expressed a mixture of positive and negative views (see Table 1). On the positive side, many of the CRs pointed out that the reduction in lost or mislaid images will lead to an immediate improvement from the GP’s as well as the patient’s perspective, due to increased efficiency of reporting and decreased need for repeated X-rays. Seven of the CRs felt that should PACS become accessible by GPs, greater satisfaction would accrue to patients by provision of more ‘joined-up’ service. One CR commented:

I guess there could be a potential that if a GP phones me up now and says, ‘I got your helpful report about Mrs Bloggs’ chest X-ray, did you really mean the left?’ Whereas before I would have had to send somebody down to a film library five miles away to go and get an X-ray packet and bring it back for me to say ‘yes’, now I can bring it up in front of me in five seconds and say ‘yes’. (R7)

On the other hand, nearly all the radiologists expressed at least some doubts concerning the value of access to PACS in primary care settings. Concerns ranged from worry that access to images in primary care could result in an increase in consulting time per patient for GPs, resulting in overall poorer service at the level of primary care. They felt that the effort required to allow such access would be a waste of NHS time and resources, and that GPs’ already scarce time with patients would face more
pressure with the additional need to examine the images together, a process we have termed ‘sharing images with patients’ (SIP). In addition, most of the CRs expressed the opinion that GPs lacked the skill to interpret radiology images, even X-rays, and most certainly those that are less anatomical, such as MRI or CT. Further doubts included the possibility of a GP layering his or her own, erroneous, interpretation of an image onto the consultant’s accompanying report, with the result of unnecessary anxiety (or, one supposes, unwarranted reassurance) for the patient. Said one CR:

If they [GPs] could see images … the question of over- and under-interpretation of seeing things and raising questions that didn’t need to be raised in the first place might come up. So the number of queries we get back might increase but I think the best phrase I’ve heard about this one is one of my surgical colleagues [who] has recently retired said, ‘you only need to send them an MRI once and they won’t ask for it ever again!’ (R4)

More than half feared that after the great expense and difficulty of implementation, SIP might have no impact at all on the patient journey.

Most of the CRs felt that SIP itself was a bad idea for other reasons than pressure of time in a GP consultation. Several expressed strong opinions referring to their own experience of the process:

you know, if you show patients images, what tends to happen is they start asking what that bit is and you know, and start to ask you very obvious things which might be genuine questions as far as they’re concerned but it’s just sort of, you know, irritating and a nonsense as far as we’re concerned. You know they’ll point to something, what’s that big blob in the front middle of the chest and you say, ‘It’s your heart, madam.’ (R16)

Another radiologist spoke of the ‘frustrating situation’ in which a patient might want ‘a biology lesson in the GP’s surgery’. R1 continued:

you feel like sometimes saying well go back to school, get some bloody A levels and go off to university and study medicine if you want to know everything there is to know. You know there has to be a limit to the amount of knowledge that you’re in a position to, you know, to give to patients.

Not all CRs shared the same frustration. Ever-expressive R7 said philosophically about his experience of showing images to patients:

A proportion of them will find it an interesting and valuable experience; a proportion of them I could be discussing the weather; and a small group of them go kind of green at the gills and say I think I’d like to sit down now.

Not surprisingly, the CRs were not consistent in their attitudes toward the idea of PACS in primary care, either as a group or as individuals. Half of the radiologists held, individually, a mixture of positive and negative views; for instance, R9 believed that while PACS in primary care offered an opportunity to create a more ‘joined-up’ medical service (positive), it would also increase the risk of errors (negative). Some of the inconsistency may stem from the nature of the interview, which was iterative rather than static, and in which the questioner continued to probe the doctor to give further consideration to the idea of PACS in primary care.
Views on PACS and service delivery at primary care level: GPs

In contrast to the CRs, most GPs at the start of the interview were unaware of or uncertain about the nature of PACS technology, so that in most cases, the interaction with the interviewer served as information provision as well as data collection. The majority of the 31 GPs saw several aspects of access to PACS technology as potentially beneficial to themselves and their patients, including reduction in the waiting times for reports, the benefit of sharing the image with patients during a consultation, and a chance for professional ‘upskilling’ to learn to read radiology images (see Table 1).

The GPs in one of our study PCTs reported that while they were often able to book same-day appointments (often at the local polyclinic) for their patients needing X-rays, the wait for ultrasound scans was unconscionably lengthy, as was the wait for all radiology reports (estimated at about 2 weeks). Hence the vast majority of GPs held positive views on PACS, contingent on the system’s perceived ability to reduce waiting times. All of the GPs interviewed expressed anxiety concerning their own ability to interpret images, and worried that they would be pressured to acquire this skill.

About half of the GPs stated, at some point during the interview, that sharing images with patients had no place in and no relevance to the GP–patient interaction. At the same time more than half of the GPs expressed the view that having recourse to SIP (to use our terminology) could be an ‘added bonus’, though it would be unlikely to change their clinical management of patients: for clinical guidance, they relied on the radiologist’s report and would continue to do so even if allowed access to the image. As one said, ‘We’re not radiologists, so we tend to take the report as gospel truth’ (G23).

Said G31, simply, ‘I can’t think of the last time I had to look at a chest X-ray.’

The interviews with GPs, though, tended to follow a sort of narrative arc as the interviewee considered, generally toward the middle or end of the conversation, the potential of SIP within the practitioner–patient dialogue. In spite of doubts expressed by most of the GPs about their own competence in reading images, GPs could see potential benefits to SIP: for example to engage and to reassure, and/or to frighten or to motivate patients into altering behaviour.

They’d [patients] love it … Well I mean I suppose they’re part and parcel of the decision-making process and you know, it’s their bodies, they can actually see the image, they can be part of a discussion if they’re interested. (G31)

G1 said:

So I think they’ll feel better, especially when it’s normal, right, and I would say look here we are, here’s your lung and this is your lung, see that’s all absolutely fine, right. So you’ve got no cancers or anything sitting there and you can see the wave of pleasure going over their faces and reassurance that everything is OK … and that’s very useful for the patient because they feel very reassured.

The same GP saw the potency of an image to motivate a patient toward behaviour change, by using an image to engender distress:
Discussion

Radiologists and GPs agreed on several issues around the potential extension of PACS into primary care in the UK. Both groups felt that the patient journey would be improved by expedited communication between GPs and CRs, as well as by better tracking of images using PACS storage technology.

These expectations of the interviewees are not necessarily supported by other research. For instance GPs expressed hope that PACS in primary care might lead to a reduction in radiology reporting times; however, the literature on this with regard to PACS is mixed. Some investigations did find an increased reporting speed [22–26] but others did not [27, 28]. The GPs we interviewed anticipated improved quality of patient consultations; Watkins [29], however, found ‘mixed opinions’ in terms of PACS’ impact on patients.

In addition, both groups expressed doubt and concern about GPs’ skills in understanding and interpreting radiologic images, and about whether their being asked to do so might undermine rather than enhance clinical management of patients by GPs. Where GPs’ and radiologists’ views most notably differed, however, was around the question of how SIP, enabled by PACS, might affect doctor–patient interaction.

Many GPs could discern a potentially positive impact of what might be termed ‘seeing without knowing’: the idea that, for a patient, being able to view an image of his or her own body might be powerful within the clinical consultation, whether or not the form or significance of the image is fully comprehended. For most (but not all) of the radiologists interviewed, sharing an image with a patient who would not be able fully to comprehend its import seemed to be of little or no benefit, and in fact was perceived as possibly detrimental (it might lead to uncertainty and confusion). For these radiologists, taken as a group, ‘seeing is knowing’ or at least ‘seeing is for knowing’: in other words, if viewing the images does not, or cannot, result in increased knowledge, there is then no benefit to the exercise. Most GPs expressed the belief, at some point during their interviews, that the impact of an image on a patient consultation might transcend the ability of the patient to understand, or of the GP to explain, that image; that there could be a benefit from ‘seeing without knowing’. What emerges is a distinct ‘cultural’ difference in attitudes between the two user groups.

Jadad and Delamothe state that ‘Realising the potential of the revolution in electronic communications will require a major shift from our ethic of competition and narrow self-interest, focused on gadgets – to one of generosity and collaboration, centred on people’ [30, p. 1144]. This is a hopeful note and our research suggests such hope is warranted: the reach of PACS into primary care offers a number of potential procedural advantages including speedier feedback of information to patients and reduced loss of images. These may be regarded as the ‘unalloyed’ benefits of PACS to primary care, both to the patient and to the practitioner; in this sense, then, they offer the potential to improve both the patients’ experience through the healthcare system (the ‘patient journey’) and, in some cases, the clinical or health outcome. In fact Peltu et al. [4] regard PACS as an example of an IT system characterized by ‘successful adoption’ whose benefits are ‘generally clear to users’.

Coeira [31] writes that ‘The utility of technology is socially shaped’, while Lundberg [8] describes the conjoined roles of equipment and people as a ‘sociotechnical web’ surrounding clinical radiology. Our interviews with GPs and with consultant radiologists serve to illustrate and emphasize
the points made by these authors. Taking a sociotechnical approach emphasizes the inseparability of the social aspects of an innovation from its deployment as a novel and superior tool. To promote PACS’ successful implementation in the NHS, especially when it moves beyond the realm of secondary care, it will be important to pay attention to the social, spatial and professional milieu in which radiologists (and other consultants), GPs and patients interact.

Conclusions

Our findings suggest that, at least in the context of the UK and the National Health Service, the potential of PACS further to permeate and positively to affect patients in primary care settings may require a significant amount of support for the social as well as the technological changes wrought by its implementation. The two groups of users (and potential users), consultant radiologists and GPs, merged in their opinions on some issues, and diverged on others. They overlapped in the valence of their beliefs on ‘process’ issues: those concerning speed and efficiency. Certainly both groups believed that PACS could lead to reduced waiting times for imaging procedures and for radiologists’ reports. Both groups also shared concerns about the ability of GPs to understand radiology images. However, GPs as a group expressed a belief that SIP could enhance their interaction with patients and might have a positive effect on patient health even without the GPs themselves having the expertise to interpret the images without guidance from radiologists’ reports, whereas CRs were more likely to discount that aspect of patient benefit. Establishing clear guidelines for and effective communication between the two user groups is likely to enhance the deployment of PACS to primary care within the NHS.

Future research

In this first phase of our research programme concerning the devolvement of PACS into primary care, the radiology consultant, the GP and the patient form a triad. In this article we have presented the voices of the radiologist and of the GP, and we hope in future to explore the patient’s views concerning PACS in a primary care context. As we move toward the second phase of our research, we hypothesize that patients will express strong opinions concerning the sharing of images and the concept of ‘seeing without knowing’, as well as about speed and efficiency of reporting. Finally, while so far the only consultants interviewed have been radiologists, we recognize that many other specialties (e.g. oncology, neurology, ENT, orthopaedics, pathology: see e.g. Kalinski et al. [32]) make extensive use of PACS technology within the hospital setting, and we plan to include their representatives in further investigation. The ‘sociotechnical web’ spun around and by PACS has far-reaching implications for patients and physicians.

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