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PLEASE SCROLL DOWN FOR TEXT.
The attitudes of Healthcare staff to IT: a comprehensive review of the research literature

<table>
<thead>
<tr>
<th>Journal:</th>
<th>Health Information and Libraries Journal</th>
</tr>
</thead>
<tbody>
<tr>
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<td>draft</td>
</tr>
<tr>
<td>Manuscript Type:</td>
<td>Review</td>
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<tr>
<td>Keywords:</td>
<td>Attitude to Health, Health Care, Research, Computer User Training</td>
</tr>
</tbody>
</table>
The attitudes of Healthcare staff to IT: a comprehensive review of the research literature

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Abstract

This article reports a systematic review of findings taken from research literature from 2000 – 2005. As healthcare services develop their use of Information technology (IT), changes are rapidly occurring. This review hoped to gain a clearer understanding of the publicly available literature on the attitudes of healthcare staff to the development, and to review the research methodologies that had been used in order to make recommendations for future research and practice. Three broad questions were identified to establish:

- the importance of a healthcare practitioners attitude to IT in practice;
- factors that might contribute to the formation of these attitudes; and
- effective methods used in changing attitudes to IT in practice.

Papers considered came from 16 countries with 52% from the USA, 10% from the United Kingdom (UK), 9% from Canada. Almost 2000 papers were initially identified in the electronic search and various inclusion criteria to reduce this number to 79 papers which were included in the review. Various professional groups were compared in these papers and included Doctors, Nurses, and Radiographers. Findings from the review were categorised for consideration from aspects of the software being used, to qualities of the participants such as age, experience and training, to factors influencing performance such as management practices.

Attitudes were both positive and negative many issues were around the flexibility of the systems and if they were fit for purpose’ along with the confidence and experience of the IT users. The literature suggests that attitudes of practitioners are a significant factor in the acceptance and efficiency of use of IT in practice. The literature also suggested that education and training was a factor for encouraging the use of IT systems. There was little evidence of effective methods that actually changed attitudes amongst healthcare practitioners. This is an area that needs further research.

Background

The use of Information Technology (IT) in the UK’s National Health Service (NHS) has a long history. Since the publication of the Information for Health Strategy [1], and more recently the “National Programme for IT” (NPfIT), computer applications within the NHS have been increasing [2].

There is also a large and growing body of literature about aspects of health informatics related to policy, hardware, software and implementation. One of the factors identified as significant in the introduction of Information technology into healthcare practice is the attitude of staff that will be required to use it. In the UK surveys undertaken by Medix (a market research company in the health sector) found that the attitudes of doctors and nurses have shown increasingly negative attitudes.[3],[4]

The Technology Acceptance Model (TAM) [5],[6] may provide a context to study the acceptance, or otherwise, of IT in the NHS. It has also been extended by Dixon into
the Information Technology Adoption Model (ITAM) [7],[8] which may provide a more comprehensive theoretical model for this study.

Twenty years ago Stronge and Brodt [9] were studying this area in the USA with their Nurses’ Attitudes Towards Computers (NATC) questionnaire and others have continued this work, using similar instruments with different findings. Sultana [10] and McBride and Nagle [11] found more positive attitudes than Stronge and Brodt [9]. Schumacher et al [12] found that students showed more positive attitudes than qualified staff, but Scarpa and Smeltzer [13] found no differences in attitude with nursing experience or educational level, but had found that experience with computers was significant. In addition Schwirian et al [14] had shown gender differences in attitude.

A recent review of the literature on eHealth has been carried out [15] but little was included on the attitudes of staff and students towards these emerging technologies.

**Methods**

**Literature Search**

In developing a search strategy, bias may arise from a number of factors including the predilection of journals to publish research with (statistically) significant findings; “Medline” bias for excluding papers not indexed in Medline and “language bias” from exclusion of non-English publications [16]. In our review the selection of appropriate sources and the development of the search strategy was a dynamic, iterative process balancing the expertise and neutrality of the librarian with the knowledge and experience of the researchers. The key principle in our selection was to be as inclusive as possible within the resources and timescales for the project whilst being open to the possibility of bias. In developing our search strategy we continually traded sensitivity (recall) against specificity (precision).

Thirteen databases (see Table 1) were identified as covering relevant material for this review. These databases were explored in a series of discussions which balanced the knowledge of the librarian on their characteristics (for example, accessibility, currency and potential relevance) and the researchers’ knowledge of the subject area. Potential search terms were applied across all these databases enabling us to explore the suitability and functionality of their search interface and the significance of their output to our review.

**Table 1: Databases included in the review**

<table>
<thead>
<tr>
<th>Database</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allied and Complementary Medicine Database (AMED)</td>
<td>*</td>
</tr>
<tr>
<td>British Nursing Index (BNI)</td>
<td>*</td>
</tr>
<tr>
<td>Cumulative Index to Nursing and Allied Health Literature (CINAHL)</td>
<td>*</td>
</tr>
<tr>
<td>Embase</td>
<td>*</td>
</tr>
<tr>
<td>Health Management Information Consortium (HMIC)</td>
<td>*</td>
</tr>
<tr>
<td>Index to Theses</td>
<td></td>
</tr>
<tr>
<td>ISI proceedings</td>
<td></td>
</tr>
</tbody>
</table>
Maternity and Infant Care (MIDIRS) *
Medline*
NHS National Research Register
PsycInfo*
Sportdiscus*
ZETOC conference search

* indicates databases searched via Ovid interface.

Developing the search strategy

In tandem with our exploration of databases, a cyclic, iterative approach to identifying appropriate search terms was undertaken. Search terms were identified through discussion between the research team, including the faculty librarian, and by scanning background material. The search strategy is detailed in Table 2.

**Table 2 : Search Strategy for database searches**

<table>
<thead>
<tr>
<th>Word group 1</th>
<th>Word group 2</th>
<th>Word group 3</th>
<th>Word group 4</th>
<th>Word group 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>(IT)</td>
<td>(health professional)</td>
<td>(attitude)</td>
<td>(research)</td>
<td>(patient / public attitude)</td>
</tr>
<tr>
<td>information tech$</td>
<td>nurs$</td>
<td>attitud$</td>
<td>research$</td>
<td>patient attitud$</td>
</tr>
<tr>
<td>communication tech$</td>
<td>doctor$</td>
<td></td>
<td>study</td>
<td>patients attitud$</td>
</tr>
<tr>
<td>ICT</td>
<td>physician$</td>
<td></td>
<td>studies</td>
<td>patient information$</td>
</tr>
<tr>
<td>comput$</td>
<td>professional$</td>
<td></td>
<td>evaluat$</td>
<td>consumer attitud$</td>
</tr>
<tr>
<td>e health</td>
<td>clinician$</td>
<td></td>
<td></td>
<td>consumer information$</td>
</tr>
<tr>
<td>ehealth</td>
<td>staff</td>
<td></td>
<td></td>
<td>public attitud$</td>
</tr>
<tr>
<td>informatics</td>
<td>health care worker$</td>
<td></td>
<td></td>
<td>publics attitud$</td>
</tr>
<tr>
<td>elearn$</td>
<td>personnel</td>
<td></td>
<td></td>
<td>public information$</td>
</tr>
<tr>
<td>technology in health care</td>
<td>therap$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>midwi$</td>
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<tr>
<td></td>
<td>dietician$</td>
<td></td>
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<tr>
<td></td>
<td>dietitian$</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>nutritionist$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>radiograph$</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>radiotherap$</td>
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<tr>
<td></td>
<td>radiolog$</td>
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<tr>
<td></td>
<td>surgeon$</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>scientist$</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>health visitor$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>dentist$</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>dental</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>physiotherap$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>medic$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes :

1. All terms within groups combined with OR; word groups 1-4 combined with AND; group 5 relating to patient / public attitude combined with groups 1-4 with NOT (to exclude studies which focussed on patient / public and not health professionals).

2. $ indicates truncation.

3. Date limit of January 2000 to December 2005 applied.
4. Where possible, the searches were limited to retrieve literature published in English.

Search terms were developed using what were considered to be the richest sources of data for this review; AMED, BNI, CINAHL, Embase, MEDLINE, SPORTDiscus and PsycInfo (“core databases” accessed on the Ovid interface).

The initial search was built on four concepts seen as being key to the research questions;

1. IT
2. Health professionals
3. Attitude
4. Research

These four concepts all to be present in the retrieved references i.e. combined together with AND in the search strategy.

On exploring the references retrieved using the four initial concepts a fifth concept was added – Public / Patient attitudes. This was combined with a NOT in order to exclude items that related to the public’s attitude to IT in healthcare.

Overall, a sensitive approach was taken to the development of the strategy, by searching for our terms using the default keyword search in the Ovid interface. This maps search terms to a range of fields including titles, subject headings, heading words and abstracts. Finding the appropriate balance between sensitivity (recall) and specificity (precision) was achieved through the iterative process of refining and testing the search terms and strategy across the seven “core databases”. This process involved randomly sampling 10% of the references retrieved.

Thesauri for the databases included in the review were checked to identify any further potential search terms and to ensure that all relevant subject headings were extracted to be included in the list of search terms. Encapsulating all relevant subject headings as search terms negated the need to perform exploded subject heading searches alongside mapping keywords to titles, subject headings and abstracts. The standard keyword search in the Ovid interface was used when searching, mapping the search terms to a default range of fields which included titles, subject headings, heading words and abstracts. This approach meant that it was unnecessary to develop separate search strategies for each of the “core databases” built around their unique subject heading structure. A single all encompassing search strategy could be developed and applied across all of the databases in the Ovid interface. Pragmatically this allowed for a single set of results to be generated from which duplicates could be removed by the Ovid “remove duplicates” tool. Logistically having a single final search strategy that could be used across the “core databases” was a real bonus for this review, reducing the complexity of having multiple strategies that would need to be run individually.

Table 3 details the search strategy used on the various databases included in the review and the number of papers (n) retrieved on each database.
Table 3  Search strategy and results

<table>
<thead>
<tr>
<th>Database</th>
<th>Search Strategy Used</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMED, BNI, CINAHL, EMBASE, HMIC, MEDLINE, PsycInfo, SportDISCUS (all on Ovid interface)</td>
<td>Full search strategy as detailed in Table 2.</td>
<td>1895</td>
</tr>
<tr>
<td>Index to Theses #</td>
<td>Limitations in search interface. Used search strategy of IT concepts combined with “health”. Gave n = 20.</td>
<td>20</td>
</tr>
<tr>
<td>ISI Proceedings</td>
<td>Full search strategy as detailed in Table 2.</td>
<td>70</td>
</tr>
<tr>
<td>MIDIRS</td>
<td>Full search strategy as detailed in Table 2 retrieved nothing – so reduced search to cover just IT concepts combined with attitude*</td>
<td>12</td>
</tr>
<tr>
<td>Zetoc</td>
<td>Limitations in search interface – can only use 1 term for each of our concepts – ran several of these through to ensure coverage of appropriate material – Effectively search strategy was… (information tech* or communication tech* or ICT or comput* or e health or ehealth or technology in health care or informatics or e learn* or elearn*) AND (attitud*)</td>
<td>17</td>
</tr>
</tbody>
</table>

Notes:

1. This gives n = 1994 total refs transferred to RefWorks.#
2. Following run of duplicate sorting in RefWorks this left final n = 1915.
3. All duplicates were deleted from the RefWorks database.
4. # Index to Theses records (n=20) were handled separately as couldn’t transfer to RefWorks.

Article selection
A data extraction sheet was developed to standardise the collection of information and enable rapid comparison between them.

The lists of potentially relevant studies from different databases were brought together using Refworks™ bibliographic management software, which allowed the removal of duplicates.[17]

The bibliographic details in the computerised database search including abstracts, where available, were either printed out or examined on the computer screen in a sifting exercise. For the sifting exercise, inclusion criteria focussing on research material examining healthcare personnel attitudes were agreed by the research team through ongoing discussions based on their experience and initial reviews of the literature. These were then used to narrow down the material. A comparison of the selections made by the reviewers was undertaken independently to reduce selection bias.

<table>
<thead>
<tr>
<th>Exclusion criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not in English</td>
</tr>
<tr>
<td>Not relevant to search aims</td>
</tr>
<tr>
<td>Before 2000</td>
</tr>
<tr>
<td>Not relevant to “health professions”</td>
</tr>
<tr>
<td>Not research (any form of original data collection)</td>
</tr>
<tr>
<td>Doesn’t consider a concept related to attitudes</td>
</tr>
<tr>
<td>Case studies involving only one person/case</td>
</tr>
<tr>
<td>Single page or less</td>
</tr>
<tr>
<td>No author identified</td>
</tr>
<tr>
<td>Letters/personal viewpoints/reflective articles/opinion pieces/commentaries on papers <strong>unless</strong> clearly relevant and “evidence-based” or collected as part of a properly designed study.</td>
</tr>
<tr>
<td>Not Pre &amp; post registration/graduate education/CPD</td>
</tr>
</tbody>
</table>

This process reduced the number of papers to 204

Full papers were acquired if they fulfilled the criteria, however even after this stage some items were excluded using the criteria shown in the table, and therefore were not included in the review.

This reduced the total number to 79 papers for data extraction.
Even when explicit inclusion criteria have been specified, decisions concerning the inclusion of individual studies remain relatively subjective Glanville & Sowden [18]. A number of papers that provided general analyses, literature reviews and other works were used to inform the review but were not included for detailed data extraction.

**Results**

**Literature Review**

A wide range of papers were reviewed, covering a variety of research methods and examining different aspects of the domain. The majority of the papers reflected quantitative and qualitative studies, mostly surveys although there were several interview studies and a few observational studies with sample sizes reflecting the variations in methods.

The papers had collected data in 16 countries with 52% from the USA. Several studies were conducted before and after of computerised systems (e.g. [19]), although the majority of studies were developed by the individual researchers often with little evidence of piloting or checking the validity and reliability of the instrument. Studies were often conducted in conjunction with the introduction of new hardware or software systems into the areas in which respondents worked (e.g. [20])

The primary focus of the studies was the attitudes of staff to IT in general but often they had a more specific or different focus and the data about staff attitudes was supplemental or tangential to the main study.

Information systems can be seen as an organised and coordinated approach by individuals to process and share information with each other. Therefore an information system contains interfacing components some of which are people,
objects and procedures. The technical system is viewed as embedded in a social system – the human activity system includes the use of computer based systems.[21].

The themes that emerged as affecting attitudes towards IT, ranged from the social system aspects of management – power, education and training, to the user specific attributes of age, gender, professional groups and previous experience and also the design of the system. These themes are summarised in the table 4:

Table 4  Themes from Literature

<table>
<thead>
<tr>
<th>Clinical Records (EMR)</th>
<th>Education and Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gohlinghorst [74]</td>
<td>Derup [86]</td>
</tr>
<tr>
<td>Chiasson &amp; Lovato [70]</td>
<td>Lee [66]</td>
</tr>
<tr>
<td>Junger [20]</td>
<td>Fischer [89]</td>
</tr>
<tr>
<td>Weir et al [71]</td>
<td>Polhamus [40]</td>
</tr>
<tr>
<td>Adams [73]</td>
<td>Chan et al [63]</td>
</tr>
<tr>
<td>Trivedi et al [72]</td>
<td>Embi et al [88]</td>
</tr>
<tr>
<td>Beuscart-Zephir [33]</td>
<td>Westerlund et al [93]</td>
</tr>
<tr>
<td>Collins et al [75]</td>
<td>Haluck et al [39]</td>
</tr>
<tr>
<td>Pagliari et al [15]</td>
<td>Sery-ble [41]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design of Software/Hardware</th>
<th>Power and decision making ability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carroll et al [68]</td>
<td>Stricklin et al [31]</td>
</tr>
<tr>
<td>Lee [66]</td>
<td>Doolan [35]</td>
</tr>
<tr>
<td>Fischer [89]</td>
<td>Pare [38]</td>
</tr>
<tr>
<td>McAlearney [69]</td>
<td>Chismar &amp; Wiley-Patton [34]</td>
</tr>
<tr>
<td></td>
<td>Beuscart-Zephir [33]</td>
</tr>
<tr>
<td></td>
<td>Loomis et al [61]</td>
</tr>
<tr>
<td></td>
<td>Timmons [32]</td>
</tr>
<tr>
<td></td>
<td>Johnston et al [36]</td>
</tr>
<tr>
<td></td>
<td>Lai et al [64]</td>
</tr>
<tr>
<td></td>
<td>Moffat et al [43]</td>
</tr>
<tr>
<td></td>
<td>Araujo et al [65]</td>
</tr>
<tr>
<td></td>
<td>Temple et al [90]</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Previous Experience</th>
<th>Telemmedicine / Imaging/Pathology Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liu et al [62]</td>
<td>Yousem &amp; Beauchamp [77]</td>
</tr>
<tr>
<td>Dixon &amp; Stewart [59]</td>
<td>Mast et al [78]</td>
</tr>
<tr>
<td>Moody et al [27]</td>
<td>Chan [63]</td>
</tr>
<tr>
<td>Ammenwerth et al [48]</td>
<td>Lehoux [83]</td>
</tr>
<tr>
<td>Loomis et al [61]</td>
<td>Demartines [87]</td>
</tr>
<tr>
<td>Balter [60]</td>
<td>Bartoloni [82]</td>
</tr>
<tr>
<td></td>
<td>Gattas et al [81]</td>
</tr>
<tr>
<td></td>
<td>Crowley et al [79]</td>
</tr>
<tr>
<td></td>
<td>Rydmark et al [80]</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Workload/Efficiency</th>
<th>Professional Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosenbloom et al [28]</td>
<td>Krall &amp; Sittig [53]</td>
</tr>
<tr>
<td>Urkin et al [24]</td>
<td>May et al [92]</td>
</tr>
<tr>
<td>Rodriguez et al [23]</td>
<td></td>
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<tr>
<td>Apkon &amp; Singhaviranon [29]</td>
<td></td>
</tr>
<tr>
<td>Moody et al [27]</td>
<td></td>
</tr>
<tr>
<td>Gadd &amp; Penrod [26]</td>
<td></td>
</tr>
<tr>
<td>Kleiner et al [25]</td>
<td></td>
</tr>
<tr>
<td>Leung [22]</td>
<td></td>
</tr>
<tr>
<td>Lee [49]</td>
<td></td>
</tr>
<tr>
<td>Porteous et al [30]</td>
<td></td>
</tr>
<tr>
<td>Ammenwerth et al [48]</td>
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</tbody>
</table>
Two types of barriers to the implementation of IT systems were identified by Leung [22]. These were cost related (both financial and time/effort) and the knowledge/attitude of end users. Incentives for the introduction of IT based systems were either economical or driven through new legislation and regulatory requirements. One finding was that computer systems enable greater accountability and evaluation, giving managers more control over healthcare services.

Both Rodriguez et al [23] and Urkin et al [24] found that physicians highlighted the potential of computerized charts with office work, preventing the loss of information and facilitating communication. However they had concerns about how patients’ records were displayed, and anticipated an increase in workload and the time taken for data entry. Kleiner et al [25] also detected concern about workload issues in their study looking at email consultations. In addition to being concerned with confidentiality issues, 80% felt that using email would increase their workload. This was also supported by Gadd & Penrod [26] who found the time taken for documentation was increased by a computerised system. Contrary to this Moody et al [27] found that more than one third of nurses, 36%, perceived that EHR had resulted in a decreased workload.

Other impacts in addition to workload, were identified by Moody et al [27] who found that respondents believed that electronic charting would lead to improved safety and patient care, and another found improved efficiency [28]. Electronic documents contained 50% more descriptors than handwritten documents. [29] Colleagues derived benefits from increased legibility, more detailed content, and the ability to generate administrative and patient-care reports.

The majority of nurses, 64%, preferred bedside documentation but also found that environmental and system barriers often prevented EHR charting at the bedside. EHRs are seen to improve the quality of documentation. [27]

Patient concerns over email communications related to effectiveness and efficiency rather than the expected security issues, with physicians in the study expressing
concern with being overwhelmed with emails. Only 10% of patients use email to communicate with physicians, although 66% indicated they would like to. [25]

**Power and decision making ability**

Stricklin et al [31] found that nurses’ work and the barriers they perceived to making changes, each appear to explain more variance in nurses’ attitudes toward computers than security issues. And that it is vital for the industry and its providers to be prepared for the myriad ways Point of Care (POC) technology will affect the practice of nurses, the end users. Home care nurses’ ultimate satisfaction and use of the technology will greatly affect not only the business success of the organization but also the structure, process, and outcomes of care to patients and their families.

The various methods that staff use to challenge the implementation of IT systems was studied by Timmons [32] who found that resistance took a wide variety of forms, including attempts to minimise use of the systems, and extensive criticism of the systems, although outright refusal to use them was rare. Resistance was as much about the ideas and ways of working that the systems embodied as it was about the technology being used. The patterns of resistance can best be summed up by the phrase ‘resistive compliance’. Another aspect of non compliance was discussed by Beuscart-Zephir [33], who found that whilst novice anaesthetists followed the system, experienced anaesthetists jumped around the questions, underlining and setting alerts etc. rendering the system useless or depersonalised.

Chismar and Wiley-Patton [34] used the Extended Technology Acceptance Model (TAM2) to examine paediatricians and showed perceived usefulness was a strong determinant of intention to use, whereas perceived ease of use and subjective norm did not significantly affect intention to use IT. Further analysis identified job relevance and results demonstrability as factors determining perceived usefulness. Physicians are willing to adopt beneficial applications in IT even if they are not easy to use, the tool used (TAM2) did not take into account the higher level of competence, intellectual and cognitive capacity that physicians generally have, also the ability to adapt to new technologies.

The success of implementation of clinical information systems was studied by Doolan [35] Presence of high level leadership was considered the single most important factor contributing to successful implementation. Each site had the aim of improving quality of care through implementation of electronic records, with emphasis placed on the clinical processes being supported by the system and not driven by them The study also identified that it is important to build on the momentum of earlier successes to achieve wide spread implementation and use of a new system. This is also supported by Johnston et al [36] in that negative attitudes towards computerisation were only displayed by physicians that do not have an existing IT system. The majority of negative attitudes are related to the cost of computerisation.

Organisationally successful implementation was about identifying champions’ and getting the right people on board Ash et al [37]. The selection of the implementation strategy depended on the experience, skills, beliefs and motivation of the key actors involved. Pare [38] concluded that healthcare IT projects are always characterised by some vagueness and projects can never be perfectly controlled or predicted.
Use of IT in education and training

The potential of IT in facilitating training has been explored in a number of studies. Haluck et al [39] suggest that program directors believe this type of technology would be beneficial but lack adequate information regarding virtual environment simulators. This was supported by Polhamus et al [40] who examined the potential for the use of technology in distance education and concluded that to make effective use of web-based resources, both technology skills and confidence in using those skills are essential. It should not be assumed that those enrolling in distance learning have the necessary technical skills to complete training successfully.

In the study by Sery-ble [41] nurses believed that the computerized presentation was an effective way to learn new material, even though only 57.1% considered themselves proficient with computers. They suggested future studies should also examine the types of medically related skills that can be effectively taught by computerized training programmes. This is supported by Zdanuk et al [42] who showed that computer based learning is beneficial for the confidence of clinicians.

Searching skills and access to adequate technology was highlighted by Moffat et al [43] as areas stopping clinicians using online information effectively. Despite general positivity Hancock et al [44] also found a need for more computer literacy, information literacy and research education.

Comparisons of professional groups

Comparisons between professional groups were often difficult. Darr et al [45] found nurses were the most enthusiastic about IT implementation, while junior doctors were the least. The junior doctors resented the system since they had to enter most of the data where as nurses stressed the positive impact of the EMR on improving patient care. Porteous et al [46] found that whilst GPs had concerns about technical issues, pharmacists were more worried about workload issues. Hospital physicians felt the system to be technically cumbersome and time consuming, in the teaching hospitals resented using the Physician Order Entry (POE) system. However, in community hospital setting, staff had been involved in developing clinical pathways resulting in a system which had a positive organisational impact as it was multidisciplinary.

Jacko [47] in a study of a range of health professions showed significant results due to the occupation of the participant. The nature of the occupations influenced the need for a more comprehensive list of possible search subjects and topics, and different search tools. Nurses need access to more sites than pharmacists and specialists, although nursing students were the most likely to be non-users of the Internet.

The fact that the requirements of the different professional groups vary was also documented by Ammenwerth et al [48]. Medics welcomed speedier access to information, recording data at the patients bedside and the ability to communicate anywhere – leading to healthcare professionals working together to provide better and improved patient care. However, Lee [49] found that whilst potential users of the ambulatory care EMR had generally positive or neutral attitudes toward the system, physician groups had less positive feelings than the other professions did.
Professional/Practice issues

Social network analysis can be used to analyse relationships between healthcare providers and to identify influential individuals who are critical to the successful implementation of IT systems [50]. Identifying barriers to successful implementation was the focus to some studies. Campbell et al [51] concluded that implementation strategies should be tailored to the environmental conditions of the practice sites. In further detail, Darr et al [45] identified six main domains of concern expressed by physicians; managerial implications of EMR, limits on professional autonomy, its impact on communication with colleagues, facilitation of research, legal defence, and influence on the professional hierarchy within the hospital. Campbell et al [51] also found six similar and related themes examining care providers’ receptivity to technological change: turf, efficacy, practice context, apprehension, time to learn, and ownership. Care providers and administrators consider a range of factors, including economic ramifications; efficacy, social pressure, and apprehension, when deciding whether and how fast to adopt telemedicine. Travers & Downs [52] also found five main themes these were: usefulness, organisational culture, relationships and partnerships, and the challenge of implementing a system developed for an academic centre environment into private practice settings.

Once implemented, user commitment and attitude change, as Krall & Sittig. [53] identified five main topics in their focus groups; efficiency, usefulness, information content, user interface and workflow as being key issues. The focus groups held generated some innovative suggestions and surprised the researchers with the level of emotional engagement.

Lee [54] found that ICU nurses were ambivalent towards a new system as some shortcomings of the manual processes were not addressed by implementing the system. However major themes were: system saves resources, individualises care plans, waiting for printouts from system, routine based and there were no consensus on nursing diagnostics, concluding that there was a shift for nurses from being patient centric to information systems centric.

Although physician productivity increased significantly after introduction of the system, Liederman [55] identified speed of the computers and extra workload as a reason for a negative attitude towards a system. Seckman et al [56] found a strong correlation was detected between adoption of technology and perceived usefulness, as well as significant differences between specialities were identified about ‘perceived usefulness’ and ‘impact’ but no differences were found in relation to perceived ‘ease of use’.

Schubart & Einbinder [57] identified the importance of organizational culture and the need for data was illuminated by the executive management interviews. The study found that compatibility with an individual’s work style and skills was associated strongly with satisfaction and continued use of the system. Improvement in care & communication was also documented by Walter et al [58]

Previous experience
Findings by Dixon & Stewart [59] showed that amongst primary care physicians, usage of IT showed significant differences among groups for intent, interest, perceived usefulness, perceived ease of use, finesse, and knowledge. This was also supported by Moody et al [27] found that amongst nurses with expertise in computer use, 80%, had a more favourable attitude toward electronic health records (EHRs) than those with less expertise. Also positive correlation between acceptance of the system and years of experience of computer systems was demonstrated. [48] Users with less positive attitudes had previously worked in areas where less thorough documentation procedures prior to the implementation of the system so post implementation the nurses experienced an increased workload in order to supply complete documentation. Possible links between the number of motivated key users and department wide acceptance of system was also explored. Acceptance increases over time as users become familiar with the system. In a follow up study [48] years of computer experience is positively correlated to initial acceptance of computer use, and concluded that the fit between the task and the selected technology is important for user acceptance. Poor fitness for use can have a negative effect on quality of patient care provision.

A study by Balter [60] found attitudes to computers and email became more positive over the years especially amongst the employees. Most managers were positive at the start of IT implementation and remained positive.

Location has been demonstrated to impact on attitude to IT, Loomis et al [61] found EMR nonusers were more likely to practice in a suburban or rural location. Nonusers were significantly less likely than users to believe that (1) physicians should computerize their medical records; (2) current EMRs are useful (3) EMRs will reduce their risk of making medical errors; and (4) EMRs will improve health care quality in their office.

Whilst Liu et al [62] found that Nurses' computer skills were significantly and positively correlated with both computer knowledge and computer attitudes; however, no significant correlation was found between computer knowledge and computer attitudes.

**Age and gender**

Although anticipated from other literature that age and gender were significant factors in attitudes to IT with female and older users being less positive, papers in this review generally did not find this to be the case (e.g. [63])

Lai et al [64] were unable to demonstrate any influence of age and gender on the translation of intention to actual implementation of a system. Loomis et al [61] found that there were no statistically significant differences in age or gender between users and non users of EMR system. Although in another study Moffat et al [43] found 41% of female GPs were non users compared to 28% male GPs, Araujo et al [65] found that computer use, age group and gender were not significant in explaining the attitude. They had however, found evidence of a strong intention towards utilisation and these intentions are conditioned by attitude.
Confidence in system privacy and confidentiality

Poor content design, system function, and system integration, led to the nurses seeing the implementation as a policy requirement, rather than enhancing care and they were further worried about privacy and legal issues. Lee [66] found that nurses’ interest in IT was limited because of concerns about inconvenient access to computers; reduced work efficiency; inability to individualize patient care and nursing speciality deficiencies.

Gadd & Penrod [26] found that partly as a result of worries that they would have an even more detrimental effect on personal and professional privacy than they had previously judged. Physicians felt disenchanted with the Electronic Medical Record (EMR). However, Loomis et al [61] established that users consider EMRs as more secure and more confidential than paper based records. Supporting this, all participants in a study by Kouri et al [67] considered adequate privacy protection as a prerequisite for development of a system.

Design of software/hardware

Ammenwerth et al [48] described how one project was required to support a “hot line” initially, because staff were handling new and complex hardware and software. Therefore they were unable to demonstrate reduced costs related to the implementation of this new technology.

Carroll et al [68] were among many studies which either directly looked at the design of software and hardware for use in healthcare settings or produced comments from participants which related to these areas. Lee [66], amongst others, found hardware availability, content design and user training/education programmes are critical issues that affect nurses’ use of computers in their daily practice. Effect of hardware availability was also underlined by McAlearney [69].

The importance of flexibility in software design and project implementation was also emphasised by Beuscart-Zephir [33] Users demonstrated that they needed to customise the options, available within the software based on their professional judgement. Software compatibility with factors related to implementation, user background and characteristics of the setting are important in influencing use. Software should be evaluated for its capability to induce change in work practices in order to achieve both short and long term relative advantage.[70]

Clinical Records/Electronic Medical Records

Whilst Weir et al [71] found overall user satisfaction was relatively low on all measures and the level of adoption was quite low, however none of the users interviewed would ever return to paper based systems. The need for good communication in software development was emphasised by Trivedi et al [72].

A well designed EMR system can provide positive benefits. Adams [73] found paper based visits records had more content, whereas computer based visit records covered more areas, and provided improved risk assessment. Although Gohlinghorst et al [74]
found nurses wanted a record of patient condition over time, despite them liking the computer charting better than the paper records. Notwithstanding this, Collins et al [75] found more comprehensive information was stored per episode than paper based systems. They also reported that patients found it easy to use but health professionals had a more complex interface and found the system more difficult to use.

Despite positive attitudes to the system were found, Junger’s study [20] also raised some questions about the hardware and software and a recommendation that users should be trained to cope with problems and computer “bugs” inherently present in today’s highly complex software environments.

Chiasson & Lovato [70] in their study of users views about new software for healthcare practice obtained user comments which reflected all five of Rogers’ [76] perceived characteristics of an innovation i.e. relative advantage; compatibility; trialability; complexity; and observability. The software slowed down project momentum and created a reflective planning group when an action oriented group was needed.

High levels of computer familiarity, welcoming attitudes and positive ratings of usability, format and utility were revealed in a study by Pagliari et al [15] Content analysis of electronic feedback revealed mainly technical queries and general expressions of satisfaction.

**Telemedicine, Imaging and Pathology**

The implementation of a Picture Archiving and Communication System (PACS) in Imaging departments had the most specific quantitative documentation [63] identified 91% in productivity gains, 70% of Radiologists reported improved diagnostic capabilities. Allied Health Professionals (AHP) productivity gained by 50% on average. Despite this, Yousem & Beauchamp [77] highlighted the Importance of consulting “customers” i.e. surgeons rather than just radiologists. Additionally, Mast et al [78] found utilisation of the system appeared to be highly dependent on the individual rather than speciality. Challenges included mapping procedural skills from one medium to another, and general confidence in the quality of the images and tools on the system. This is supported by the work of Crowley et al [79] who studied the use of pathology images in the electronic record and found that image quality and issues of access and interpretation needed further evaluation.

Satisfactory quality of images and audio, even improvements to what existing facilities offered was documented by Rydmark et al [80] and Gattas et al [81], Bartoloni [82] evaluated the ease of setting up systems in remote locations, reflecting an important factor in system design. Another study found that analysis of existing structures will improve uptake by system users. Lehoux [83], found technology doesn’t always reflect existing structures and use of technology reflects fitness for purpose, and concluded that Software designers often impose structures on users.

**Decision Support**

Mixed responses were found with systems designed for decision support. Bauer [84] found staff were generally satisfied with the system and found that it was to some
benefit to their practice, whilst Rosseau et al [85] found negative comments about the 
decision support system significantly outweighed the positive or neutral comments. 
Respondents did not feel that the system fitted well within the general practice context 
with concerns emerging in three main themes, timing of the guideline trigger, ease of 
use of the system, and helpfulness of the content.

Discussion

This review aimed to identify relevant literature, review and summarise the 
methodologies and findings and make recommendations for future practice and 
research in the area.

The process of identification, selection and review of the articles included in the 
review was complex and time consuming. The initial search was carried out in late 
2005 and therefore more recent articles were not included. The keywords and 
databases used gave a wide coverage and while not guaranteed to be comprehensive, 
do give a reflection of the information which has been published in this area. Data 
extraction and thematic analysis is a subjective process based on the knowledge and 
interests of the research team, but with a series of checks and protocols in place to 
make this as systematic as possible.

A wide range of material was reviewed from around the world which revealed some 
high degrees of consistency amongst the studies, but also findings that were unique to 
a particular country or healthcare system [22],[86]. This added some interesting ideas 
and views to the review.

Much of the literature reviewed used questionnaires as the data collection method 
although, interviews focus groups and observation was also represented. In very few 
cases [55] were attempts made to measure the effects on patients although this may 
sometimes be inferred by the views of the healthcare professionals involved. This is 
an area that requires further research.

Overwhelmingly, the issues that affected healthcare professionals’ use of computers 
in their daily practice were hardware availability; content design and user 
training/education programmes [36],[66]. The specific computer hardware and 
software programs varied in the papers but there were consistent issues about the 
fitness for purpose, and usability for most.

Many of the studies included in the review related to the introduction of electronic 
patient records [20], [71], [73] reflecting their increasing development and use during 
the time period, although studies examining telemedicine, pathology and radiography 
systems were also included [81],[82],[83]. Many users were willing to overcome 
some of the difficulties of implementation if they saw long term benefits. This focus 
amongst the studies included in this review may reflect a particular point in systems 
lifecycles, and different views about the use of IT may be found if more studies were 
conducted at different stages in the process if longitudinal studies were carried out 
over a number of years.
A variety of studies considered the education and training needed for successful use of healthcare IT systems and others looked at the use of IT in more general education and training [63], [88]. Comments included the needs expressed by users both for more education and training before the implementation of IT based work systems and for more on the use of e-learning approaches to learn about professional healthcare practice.

Experienced IT users tended to have more positive attitudes towards its introduction and use in their work setting [48]. A more significant factor in many of the studies was the relationship between the IT system and the user’s professional roles and power relationships, with some individuals seeing challenges to their role and traditional practice, as seen in Timmons study [32] when he refers to ‘resistive compliance’. Explanation of the value of IT systems is therefore a necessary part of staff preparation when planning implementation or change.

Some issues were frequently cited about the introduction and use of new IT systems and their effects on workload and efficiency and perceived issues around privacy and confidentiality [67]. Particular issues arose within the first six to twelve months of implementation when the change is hardest and efficiency gains had yet to be obtained.

Some of the major issues identified related to the drivers for implementation, which were often “top down” and the implementation at lower levels in the organisation. Generally those systems with a clear design and which build in education and training were conceived to be the most successful. The previous IT experience of the users was also important in influencing implementation.

There have been significant changes and investment in the UK’s NHS in relation to IT over the last five years, and many of the issues found in this review may have already been addressed. However it is likely that as issues around IT implementation are becoming concerns for a range of managers at practice level the factors identified could be argued to be more relevant than ever. Those responsible for implementation at national and local levels will need to take the findings into account and invest time and effort into strategies which are likely to produce more positive attitudes amongst the workforce.

Conclusions

This study, provides a comprehensive review of the literature related to healthcare staffs attitudes towards IT, providing an overview of current developments, and identifying key factors which influence these attitudes.

A range of key issues, such as the need for flexibility and usability, appropriate education and training and the need for the software to be “fit for purpose”, showed that organisations need to plan carefully when proposing the introduction of IT based systems into work practices. Also, those organisations could benefit from involving users with higher levels of previous experience of IT as they tended to have more positive attitudes. Education in the use of IT for healthcare professionals at undergraduate and postgraduate or continuing education levels is therefore an
important aspect. These findings need to be taken into account in future programme development and implementation.

The studies reviewed did suggest that attitudes of HCPs can be a significant factor in the acceptance and efficiency of use of IT in practice. However there do not appear to be any consistent indicators of their likely attitude other than experience and confidence in using IT.

Further qualitative and quantitative research is needed into the approaches which have most effect on the attitudes of healthcare staff towards IT and consideration given to the strategies which are likely to be most effective. This may include the use of the IT systems found in practice settings in educational environments.

Competing interests
Philip Brentnall is currently working for a supplier to the NPfIT PACS/RIS programme, delivering information systems to Radiology Departments throughout the South West.

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Authors' contributions
RW originated the project and coordinated management of the project and paper preparation. He led on the background, data extraction and theme development sections of the paper. CS and PB helped in the creation of the project proposal, literature searching, data extraction and analysis. CS led on the abstract, discussion and conclusions section of the paper. PB led on the results section of the paper. JB led on the literature searching and participated in data extraction. He led on the literature searching section of the paper.

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