Why oh why HI? Using clinical audit to teach Health Informatics

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Abstract
Teaching Health Informatics to undergraduate medical students requires approaches that make informatics relevant to students’ learning and clinical practice. Health Informatics has been taught for 10 years to undergraduates at the University of Otago, Wellington by clinicians and librarians. In the last 2 years an innovative approach to teaching informatics skills has been adopted using a clinical audit project, which is integrated with students’ clinical learning. The audit projects have been conducted in a Methadone clinic and in a hospital setting where the students audit the adequacy and completeness of the neurological and mental status examinations. Students collect and analyse data using Microsoft Access, use electronic patient records, conduct a literature search and present their findings as a report and orally. This paper will outline the curriculum, course objectives, teaching and learning activities and discuss students’ learning, lessons learned, and future directions.
Introduction

Undergraduate medical students at the University of Otago, Wellington (UOW) undertake a project which integrates Health Informatics (HI) with clinical audit and clinical placements. This paper discusses the development of the HI course over the past decade, course innovations that have made HI relevant to students, and the teaching collaboration between clinicians and librarians.

The need for HI skills for medical students has been defined by the Medical School Objectives Project as follows: “To support health care, life-long learning, education, research and management, medical students should be able, at the time of graduation, to utilize biomedical information for: formulating problems; arriving at strategies for solutions; collecting, critiquing and analyzing information; taking action based on findings; and communicating and documenting these processes and the results.” (1)

The need for graduates to be skilled in audit has also been identified (2-4). Clinicians need to have the tools, particularly audit skills, to evaluate clinical care and improve the quality of care and services. The Medical Council of New Zealand requires doctors to perform audits as part of their continuing professional development (5).

Our goals for informatics teaching were that students should demonstrate

- computer literacy
- an ability to undertake audit or research in clinical practice by collecting, analysing and summarising data
- an ability to communicate information effectively
- ethical behaviour and compliance with network/system and data security requirements relevant to information technology in medicine
- the ability to use electronic personal health records effectively.

The Medical School, medical degree and students

The medical degree at the University of Otago takes 6 years and students spend their first 3 years in Dunedin studying foundation medical science before completing 3 years at one of the clinical schools in Dunedin, Christchurch or Wellington. Approximately 80-90 students are in each year class at the UOW. The students undertake clinical placements at Wellington and Kenepuru Hospitals (part of the Capital and Coast District Health Board), at other hospitals in the Wellington region, and in a variety of community settings.

During their 4th year the students rotate in groups through clinical runs in Medicine, Community Practice, Public Health, Clinical Skills and Gastroenterology, and Surgical and Clinical Skills. Students also study Pathology, Clinical Decision Making (evidence-based medicine), Professional Skills, Attitudes and Ethics, Addiction Medicine and Health Informatics.

HI course background
At UOW, HI has been taught to undergraduate students in their 4th year since 1999. It was originally taught as a stand-alone course, before being integrated into the Medicine run in 2007.

The teaching team consisted of two clinicians (senior lecturers in General Practice and neurology), and three non-clinical tutors including one course tutor/coordinator with a library background and two librarians.

At its inception the course consisted of self-study web-based modules in Medline, Excel, PowerPoint, Access and Internet Searching, and a project. Both the modules and the project were assessed. The course evolved in response to formal student feedback and tutor review so that by 2006 only Medline and Access were taught as separate modules as these specifically equipped students with the skills required to complete the project. There was also a change from web-based modules to face-to-face teaching sessions as the students were more accustomed to face-to-face teaching.

Individual students collected anonymous patient data during their clinical runs for the project; the data was recorded in a logbook and then entered into a web-based database. Working in groups the students chose topics for investigation, formulated hypotheses, searched the literature and analysed the data using Access. Each group produced a report and made a presentation to the whole class and teachers. As well as using informatics skills the project was intended to use whole-class learning to increase students’ experience of a wide range of clinical encounters because individual students see a limited number of patients (and therefore conditions).

Ethics approval was gained for this project and the subsequent audit projects. A workshop on privacy issues in the context of electronic health records was made part of the clinical introductory programme.

By 2006 it became clear that teaching and learning informatics would be more effective if the course was embedded into clinical work where the purpose and need for the skills would be clear to the students. Students questioned the relevance of the project and thought that the data collection impinged on their clinical learning time; the oft repeated refrain was ‘why oh why HI?’ . Student feedback indicated there needed to be a clearer connection between informatics and clinical work. Discussions with a GP and a surgeon about how they used informatics skills to manage information and data and perform audits helped crystallise the proposition that audit could be an appropriate context for teaching informatics. A summary of the curricula of US medical schools’ which teach quality improvement (QI) concluded that QI should be integrated into existing curricula, putting the content into context and improving students’ knowledge and skills (6).

There are a number of reports of undergraduate audit projects conducted in primary care (4, 7-13). Rhodes et. al. (14) developed a 6 week full time course integrating evidence-based medicine, ethics, audit, change management and clinical epidemiology in a variety of primary and secondary care settings.

In 2007 and 2008 HI was taught using two clinical audit projects. The first project was carried out in an outpatient’s methadone clinic, and the second in a community hospital setting.
The process of an audit

Clinical audit is “the systematic peer evaluation of an aspect of patient care. The process, which may be multidisciplinary, involves a cycle of continuous improvement of care based on explicit and measurable indicators of quality.” (15)

The following steps for the audit were identified based on the literature (15-20):
1. Choose audit topic and decide on objectives i.e. what is the audit trying to achieve
2. Select audit team
3. Decide audit criteria. “Audit criteria are explicit statements defining the outcome to be measured”. (16) Setting criteria clarify what is to be measured and what data should be collected.
4. Set the audit standards. Standards should define the desired level or quality of care (15, 18). Standards may be defined by guidelines or policies, or formulated with reference to published literature and/or discussion with clinicians.
5. Decide on the audit method
6. Observe practice and collect data
7. Analyse data and compare performance with the standards
8. Present results and plan improvement/make recommendations for improvements
9. Implement improvements
10. Review or re-audit

Project objectives

The objectives of the projects were that the students be able to:
- Explain the role of audit in clinical practice and in service improvement
- Identify criteria/standards appropriate for the service
- Compare practice with criteria/standards
- Explain why practice may differ from the standards
- Propose how the service might change to apply findings to practice
- Identify and use information sources needed for study and clinical practice
- Collect, store, manage and analyse data using electronic health records, spreadsheets and databases
- Appraise and compare evidence from the literature
- Explain ethical issues in relation to the audit project
- Participate in multi-disciplinary team clinical meetings

The methadone clinic audit project

The 2007 clinical audit project was undertaken at the Opioid Treatment Service (methadone clinic) which is part of the Capital and Coast District Health Board’s Alcohol and Drug Clinic. This project offered the opportunity for students to learn a neglected area of medical education linking drug and alcohol, community medicine and psychiatry.
The audit topic and standards

Discussions between the teaching staff and clinic staff identified two areas of practice for audit:
1. Were patients screened for Hepatitis B and Hepatitis C on admission to the clinic?
   Clinic policy requires that patients be tested as part of the process of acceptance onto the methadone programme. Hepatitis C is a serious problem for about 25% of infected persons and assessment of risk status requires invasive testing. Because patients have multiple management issues hepatitis testing is often not a high priority for clinic staff. In addition patients who had tested positive for Hepatitis C may or may not have been referred to the gastroenterology clinic.
2. Did patients who were prescribed benzodiazepines undergo a psychiatric assessment?
   Benzodiazepine abuse and dependence is common among those prescribed methadone and it is commonly used illicitly. The clinic’s policy is that methadone is prescribed for specific psychiatric indications and in consultation with the clinic’s psychiatrist and multi-disciplinary team.

Methods

The hepatitis project was carried out in the first half of the year, and the benzodiazepines project in the second. Students spent one morning a week on the project, completing it in 5 weeks. Each student also had a half-day clinical placement at the clinic before beginning the project.

Clinic staff attended the first session to discuss the topic in the context of care and rehabilitation of the addicted person, the reasons behind the audit, and the audit criteria and standards. Individually, students spent 2 mornings collecting data from patient files; they found it difficult to navigate the files which contained letters, reports and results sometimes dating back more than 10 years. Additional data on test results and gastroenterology referrals were obtained from the electronic patient records. Students entered the data into an Access database which had been designed and constructed by the teaching team. One morning was spent learning Access skills needed to analyse the data (how to do queries) and another morning on literature searching. In groups of 6-7 students, the students analysed the data, did a literature search, wrote a report and gave a presentation to the clinic staff and teaching team.

Students made useful and positive recommendations to the clinic staff such as designing a form which could be kept in the patients’ files to record when hepatitis tests had been performed. They also made recommendations about how information could be organised in patients’ files which would make it easier for clinic staff to find out if tests or psychiatric examinations had been performed.

Student feedback

Student feedback showed that they liked or learned the following aspects of the project:
- Learning about the Alcohol & Drug clinic/hepatitis/benzodiazepines (48%)
- Learning how to do audit/research/project work (46%)
- Learning to use an Access database (41%)
• Doing something ‘real’ for a service (19%)
• Group/team work (19%)
• Looking at patients’ notes (12%)

Students reported that they disliked these aspects of the project:
• Data collection and entry (26%)
• Being unclear about the objectives/outcomes (16%)
• Using Access (12%)
• Group/team work (8%)
• Having a lack of autonomy or no input into methodology or design of the audits and the databases. Conflict between ‘spoon feeding’ and independent learning (6%)

In summary the teaching team felt that the projects were exciting, but the standards proved intangible, the case note review process was highly educational but demanding in the time available, and the data analysis was complex.

The mental status and neurological assessment audit project

In 2008 it was decided to devise a project more relevant to the learning taking place in the rest of the students’ clinical run. The students were attached for the 5 week Medicine run to 2 wards of a community hospital, an acute medical ward and a rehabilitation service. During the same period they were also studying neurology and attached to a neurology outpatients clinic.

The following were the rationales for integrating the project with clinical placements
• To focus student learning in neurology, the area of expertise of the clinical tutor
• To use the audit as a means of increasing student contact with patients
• To increase student examination and history taking skills in patients with neurological illness

In addition to the overall project objectives the specific clinical objectives were that the students have:
• An ability to do a neurological assessment, including mental status
• An ability to interpret neurological assessment in light of patient history
• An ability to contribute to the ward team and improve the quality of patient care
• An understanding of how the hospital system works for Resident Medical Officers (RMOs)

The audit topic and standards

The audit topic required students to assess the completeness and quality of neurological assessments done by the Resident Medical Officers (RMOs) and compare the performance of the RMOs with their own findings.

The following criteria were defined for the students:
• Did the RMO do an adequate neurological examination?
• Did the RMO recognize if the patient had impaired mental status?
• If impaired mental status was recognised, did the RMO consider and record the likely cause?

Specifically, students had to find out the following:
• Whether the patient had mental status impairment
• If the patient had mental status impairment, why? Did the patient have delirium or dementia?
• Whether the patient had neurological problems

Students had to record the differences between their findings and those of the RMO and decide and record if any of the differences between their and the RMO examinations were clinically significant. The students’ examinations were considered to be the gold standard.

Methods

Students spent one morning a week on the project plus time on the wards seeing patients. They collected information from the patient’s file which had been recorded by the RMO during the patient’s admission. Students then completed an interview, a neurological examination and a mental status examination on each patient and recorded their and the RMO’s findings manually on data entry forms. They examined 3 or 4 patients during the run. Each student entered their data into a multi-user Access database which had been designed and constructed by the teaching staff. As in 2007 one morning was spent learning Access queries and one morning on literature searching. Students worked in groups of 6-7 to analyse the data, do a literature search, write a report and make a presentation. The course programme is detailed in Appendix 1.

Student feedback

Student feedback showed that they liked or learned the following aspects of the project:
• Practising doing neurological and mental status examinations/clinical skills (59%)
• Learning about the importance of doing audit and how to do it (56%)
• Patient contact (26%)
• Group/team work (25%)
• Using Access (17%)
• Learning about the importance of adequate documentation/note taking and writing patient records (15%)
• Learning about hospital systems/administration (7%)
• Data analysis (7%)
• Literature searching (4%)
• Writing reports/scientific paper (3%)
• Time management (1%)
• Presentation skills (1%)
• Using Excel to create tables/graphs (1%)
Students disliked the following:

- Audit project taking up too much time in the run (13%)
- Uncertainty regarding objectives/outcomes of project (13%)
- Travel to the hospital/starting at 8.30 a.m. (10%)
- Data collection and entry (7%)
- Not having enough time to do project (6%)
- Group/team work (4%)
- Using Access (3%)
- Examining or trying to communicate with unwell patients (3%)
- Finding convenient time to see patients (2%)
- Not being able to design the audit or choose the topic (2%)
- Literature searching (1%)

Informally students expressed concerns about criticising clinical practice, making recommendations for change when they had limited clinical experience, and that their own examinations were considered as the gold standard when they had little practice in clinical examinations and history taking. This could be viewed as developing maturity as clinicians and investigators.

Students also took part in a focus group and their comments reinforced that the primary areas of learning were in understanding audit in a hospital context, in examination skills, the diagnosis of dementia and delirium, hospital procedures and administration, interaction with patients and the importance of note taking. Areas for improvement identified by students were around understanding the project as a whole, the importance of having more input into the design and construction of the project, and more clarity about literature searching.

**Discussion**

**Team work**

The librarians on the teaching team benefitted from exposure to clinical matters which raised their understanding of clinical issues and conditions. However this also caused some difficulties at times; students would ask the tutors for help with clinical questions or interpretation of clinical data which was outside the tutors’ expertise. Attendance by a clinician at all the sessions, while desirable, was not always possible due to clinical commitments.

**Time frame**

Opinions on the length of time needed for an audit project vary. Some students thought that there was not enough time to do the research and writing up or that the project would be better done in a block rather than spread over 5 weeks. Others thought the project took up too much time in a busy run. It has been suggested that students need to be at a practice longitudinally for an adequate length of time to perform a quality improvement project (6). Henley (7) found that an audit project run once a week over 6 weeks could be completed, but without the students participating in the development of the audit tool.

The teaching team felt that a longer time frame for the project would have the following advantages:
• Time for the students to participate in planning the project method, and designing and constructing the Access database. This would give students experience in project design, a better understanding of the objectives of the project, and greater autonomy which would enhance student engagement.
• More time for discussion and for the students to reflect on their findings and their learning from doing the project. The teaching team would like to have had time to give formative feedback on the report before the students presented their results to the clinical staff.
• A much longer time frame might allow students to complete the later steps of the audit cycle such as re-auditing after improvements or changes had been made. Other strategies could be devised to meet this goal, for instance reviewing the findings of students who had done the audit in the previous year. However a longer time frame would have to fit in with the already full curriculum.

Knowledge and understanding of audit
Although most students recognised the value of audit and the need to audit their own performance they could benefit from more formal discussion of audit and quality improvement. This could be done in collaboration with the hospital’s quality improvement unit. Putting the project in the context of the hospital’s requirements for audit prepares students for working knowledge of hospital systems and procedures which is needed when they become RMOs. It also prepares them for their professional development requirements.

Computer literacy
Levels of student computer literacy vary. Students who had used Access before usually took responsibility for data analysis for their group. Access is a powerful data analysis tool but with limited time available the students were only taught enough to enable them to do the project. However some students have transferred the Access skills they learned on the audit project to other projects.

Computer hardware
Ideally students would be provided with laptops or PDAs so that data could be entered directly without manual data collection. We were able to provide laptops at some supervised weekly sessions for data collection at the offsite methadone clinic. Unfortunately resources did not allow us to have laptops for the hospital-based project where they would have been needed for weeks at a time. While it would be desirable to have laptops, data security and confidentiality issues have to be addressed. In 2007 the laptops were kept locked away when not being used for the data collection and all data was removed at the end of the project.

Information literacy skills
Literature searching skills were varied with some students having had little practice in using Medline. Searching for evidence for the adequacy and completeness of mental status examinations and neurological examinations was difficult as these topics required more advanced understanding of and skill in constructing search strategies than most students were capable of. There is very little relevant literature on the neurological examination, which illustrates the novel aspect of the project. This presented challenges for the librarians in the literature searching session which were
addressed by discussion of how to plan a search and by searching other databases such as Embase.

Conclusion

Two years’ experience in running clinical audit projects integrating HI with clinical placements has demonstrated that students value the opportunity to do a project which is of real benefit to a service as well as making them aware of the requirements and process of audit. Teaching informatics using audit in a clinical context enabled teaching staff to address the ‘why HI?’ question and make HI relevant to the students. A multi-disciplinary approach to teaching can be successful using skills of librarians and clinicians. Some future directions for teaching HI might be carrying out audit projects in primary care or other hospital settings, or expanding into the broader area of quality improvement.

References

20. Sale D. Quality assurance for nurses and other members of the healthcare team Houndmills, Basingstoke, Hampshire: Macmillan; 1996.
Appendix 1

The mental status and neurological assessment audit project - course outline

| Week 1 | Session 1 | 1 hour | Introduction to principles of audit, an outline of the project, defining the criteria and setting the standards
|        | Clinical work |       | Introduction to the data collection forms, the Addenbrookes (ACE-R) test and the Mini Mental Status Examination (MMSE or Folstein) for cognitive testing
|        | Session 2 | 3 hours | Introduction to Access, the database structure, tables and data entry forms
|        |          |         | Data entry of patient data from the previous day
|        |          |         | Discussion and resolution of practical issues relating to data collection and patient encounters
| Week 2 | Clinical work |       | Patient examination/interviews and data collection
|        | Session 3 | 3 hours | Introduction to Access queries
|        |          |         | Data entry
|        |          |         | Discussion and resolution of any ongoing practical issues
| Week 3 | Clinical work |       | Patient examination/interviews and data collection
|        | Session 4 | 3 hours | Literature searching: Medline and other databases
|        |          |         | Data entry
| Week 4 | Clinical work |       | Patient examination/interviews and data collection
|        | Session 5 | 3 hours | Completion of data entry
|        |          |         | Data analysis
| Week 5 | Session 6 | 3 hours | Report writing and preparing PowerPoint presentation
|        | Session 7 | 1 hour | Students’ presentations