NEW EDUCATIONAL METHOD

Integrating suitability for teaching into an electronic health record - A novel and versatile tool for medical education

[version 2]

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Abstract
This article was migrated. The article was marked as recommended.

The educational literature has noted the implications of electronic health records (EHR) for patient care and discussed various implications for the learner-teacher relationship but it has so far not viewed EHR as an educational tool. We wondered whether we could use EHR to facilitate undergraduate medical students’ exposure to hospital in-patients with an interesting history or findings on clinical examination. As clinicians, we encounter such patients on a regular basis during ward rounds and referrals but students are often absent during these encounters, leading to a loss of learning opportunities. Our aim was therefore to harness the EHR and create an electronic “flag” that, following consent, document suitable inpatients and thus maximise the students’ exposure to patients who present learning opportunities. With help from our IT department we developed a simple add on to our existing EHR that allows any clinician to electronically highlight and document such patients during inpatient encounters. A member of the educational faculty can, whenever required, interrogate the EHR for the presence of inpatients with interesting findings on examination in the hospital and facilitate contact with our medical students. We report details of our approach, describe early experience and potential pitfalls and suggest future applications.
**Introduction**

Medical Schools are currently training a generation of students for a workplace that will be dominated by electronic health records (EHR). The terms electronic medical record (EMR) and electronic health record (EHR) have been used interchangeably, although differences exist. The EMR is essentially a digital version of the paper charts created by one provider whereas the EHR (Gunter and Terry, 2005) includes shared data from multiple providers. In contrast, a personal health record (PHR) is an application for recording personal medical data that is patient-controlled and made available to healthcare providers.

The educational literature has described implications of EHR for quite some time now. Some medical professionals are sceptical (Hammoud et al., 2012b) or ambivalent about many of the changes brought about by EHRs (Ellaway, Graves and Greene, 2013). Some authors have postulated competencies that Medical Schools should teach to prepare their students for the digital workplace of the future (Hammoud et al., 2012a). Others have studied how undergraduate medical students access and use EHR and raised the issue of how much time students should actually spend on computers (Chi et al., 2014). While many EHR systems allow for student login and other options, such as writing notes, there is limited data on how to modify EHR systems for educational purposes although Elliott and co-workers reported early experience with a student-centred EHR (Elliott, Judd and McColl, 2011).

In our practice in a large teaching hospital there are often patients, which we want to highlight to our undergraduate medical students, for example because of an interesting history or because they exhibit rare but important signs on clinical examination. Good examples include the murmur of aortic regurgitation, a vasculitic rash, or palpable splenomegaly. All three are important but reasonably rare in inpatients, difficult to appreciate without being in a room with the patient, and near impossible to teach with simulation or technology. In our clinical practice, we noted the increasing use of electronic “tags” on groups of patients for clinical purposes for example to highlight patients with renal impairment, allergies or diabetes. We wondered whether such electronic labels could be used for educational purposes.

**Methods and Results**

**Study setting**

Our hospital trust operates two hospital sites in the North West of England with 920 beds in total and most specialties on site with the exception of cardiothoracic surgery. It hosts around 280 medical students who are on a five year MBChB course with Manchester University and spend all of their three clinical years at our institution. The hospital trust operates a QuadraMed™ EHR system (Quadramed Corp., Plano/Tx, USA). The system in our institution fulfils the criteria for EHR as it includes access to laboratory results and imaging but also to primary care documentation via a Health information Exchange platform (Tiani GmbH, Vienna, Austria).

**Methods**

We first discussed the idea in spring 2016, liaised with our IT department and eventually submitted a change request to establish an additional “teaching label” on the EHR. We presented the request to the hospital trusts change board, which approved the request. The new facility on our EHR became functional as of September 2017. The “labelling” is easy to use (Figure 1): Users choose “order” (Panel A, blue arrow) as if they would to order a laboratory test, imaging, or medication and then choose “Teaching Patient”. This will open up a drop down menu and the clinician can select the relevant specialty and the relevant finding from a range of options. The final step involves accepting the “order”. Of note, we ask for verbal consent (as we would have done in the past to gain consent to demonstrate findings to students) and we have also included a function to remove patients from the list if they so choose. We also carried out a very brief paper based survey among one group of Year 3 students in academic year 2017/18 (n=8).

**Results**

We limited our project to one senior clinician and one group of eight year 3 undergraduates during Academic year 2017/18. For convenience we chose our respiratory placement since one of the authors of this work is a respiratory physician. The Year 3 students had already been on the wards for initial induction and had been taught how to access the EHR. When they started in our Respiratory/Acute Medicine placement, we delivered the timetable as usual for 3 weeks and then taught students how to access the EHR patient list for the next 3 weeks.

Normally the students would find suitable patients for history taking and examination solely by asking ward staff. Clinicians found the system extremely user-friendly and would typically complete the process of “labelling” in around 1-2 minutes, from taking verbal consent and documenting this in the notes to completing the process. Overall the student experience was very positive. In particular students commented in their verbal feedback that they were able to access more patients to their satisfaction and that the new approach greatly facilitated their exposure to interesting histories and findings on examination. In a brief survey of student satisfaction most students agreed or agreed strongly with the utility
of our new approach (Table 1). Some lower scores were received from some students with regards to ease of use for identification of patients (Q3) and for tracking (Q6).

Anecdotal feedback from patients, relatives and staff not involved in this project did not suggest any issues with this approach although as a team we had some concerns ourselves: Importantly, we were concerned about patients being overwhelmed by large numbers of students. We were also considered the possibility that students would exchange information about interesting patients in between groups and therefore counteract our efforts to minimise crowding. Neither did occur in our pilot, presumably due to the relatively small number of students involved but may well be an issue if rolled out across the entire year 3 of just under 100 students.

**Discussion**

The implications of EHR for training the future workforce have been discussed previously, including concerns that EHR may alter the interaction between teachers and learners. There is however widespread consensus that the EHR is changing
the clinical environment and that educational practice needs to respond (Elliott, Judd and McColl, 2011). Here, we describe how educators can actually use the EHR for medical education by electronically “labelling” those patients who are willing to participate in teaching and who have an interesting history or interesting findings on examination to make them particularly suitable for teaching.

What our little report adds is a simple useful and versatile tool to harness EHR for educational purposes: Apart from the use described here we also see an opportunity for organising and hosting exams: It would be easy to widen the initial consent to include approval to be approached for exams and teaching after discharge. The electronic flag could be used to feed into a database of suitable patients for exams and postgraduate courses. There is also an opportunity here in rewarding patients for their participation in teaching: As an example, patients who have participated repeatedly could be sent a thank you letter and invited to participate in educational activities as expert patients. It could also be used to track cases over a longitudinal period and students could do case studies both in and out of hospital to enhance their understanding of the case.

This issue we address i.e. the mismatch of educationally rewarding cases and undergraduate student presence is becoming increasingly relevant for several reasons: Firstly, the turnover of patients is accelerating all the time with a national drive for outpatient management, so that patients with such findings will inevitably spend less time in hospital than they used to. Secondly, our students’ timetables are increasingly prescriptive with multiple commitments, such as skills training, group teaching, and communication training and students spend less time on wards than they used to. There is also pressure to accommodate more learners generally (Melvin et al.). Thirdly, we as clinician educators are increasingly busy and lack the time to find students when presented with an interesting finding during ward rounds or when doing inpatient referrals.

Our approach has advantages, mainly the fact that it incurs very little cost (assuming that an in house IT department can facilitate the required software changes), requires very little or no training, and avoids an additional industry of databases or paper records of patients who are suitable for teaching. We emphasise the need for a user-friendly approach and we regarded the simplicity of our solution as a key to success: Clinicians are already used to ordering laboratory tests,
imaging, or medication in the way described and all we have added is the “suitability for teaching” as an additional item on the order list.

We also acknowledge the limitations of our study. Our report lacks data on actual usage and student satisfaction. One key issue we envisage is that of crowding caused by student demand for unusual findings in a given patient. We have identified several options to address this when we roll out this approach to the entire Year 3 with just under 100 students. Firstly, we are planning to limit access to placement supervisors and educational staff as opposed to giving students direct access to the database. This will also likely enhance the educational value of our approach by a tutor guiding students to suitable patients or selecting presentations that contrast or complement each other (for example highlighting a patient with mitral stenosis to a group who has just seen a patient with mitral regurgitation). An additional challenge this would address is to find an appropriate balance between common and rare clinical scenarios. In this regard the tutor could ensure that such a balance is maintained whereas if the students had direct access to the database they may focus on more unusual scenarios. It may also be necessary to limit students’ access by area, so that for example a patient with cardiac murmur is only accessible to students on our cardiology and respiratory Year 3 placements as opposed to the entire cohort. A final option would be to incorporate an electronic “counter” in the system that counts student encounters with a given patient and flags once a specified number of encounters have been reached.

It is worth reflecting on wider implications of our approach. Others have emphasised that technology should be regarded as a matter of ethics and professionalism and not solely as one of instrumentation (Ellaway, 2014). Bardach and colleagues note that use of EHR can affect inter-professional communication, often in subtle ways (Bardach, Real and Bardach, 2017). In this regard directing students to patients by means of technology may ever so slightly dis-incentivise them to for example speak to the ward manager or trainee doctors to find suitable patients in the clinical workplace. It is also possible that our approach may affect the willingness of patients to interact with students: Patients may be more willing to spend time with learners if they have been introduced by a clinician with whom they have a longstanding professional relationship and they may be sceptical or less willing if the contact is facilitated by the EHR. In our further evaluation of this approach we are planning to incorporate feedback from patients, relatives and ward staff to seek for evidence along these lines.

We were also slightly concerned about consent and sought advice from our IT change board who took the view that consent should be taken in the usual way i.e. verbally and that this should be documented in the notes. Students were also asked to seek permission again verbally before seeing a patient. Our survey of student satisfaction (Table 1) also suggests that ease of use and utility for patient tracking can be improved.

An additional minor issue we can envisage is the need to encourage and motivate already busy clinicians outside the core educational faculty to use this system and enrol patients during their busy clinical work. An element of technology fatigue and reduced enthusiasm caused by increased use of EHR for teaching has been described previously (Spencer et al., 2012). Our approach will be to advertise the new development and perhaps reward enthusiastic adopters in our existing system of teaching awards. We also recognise that our hospital’s IT infrastructure was key to the success of our project and that lack of access to IT resources or use of an off-the-shelf EHR may preclude the approach described here. Finally we acknowledge that our previous longstanding involvement in IT design and development in our institution helped us enormously to drive this project forward.

Take Home Messages
Our early experience with an electronic flag for educationally rewarding patients has been very positive and we would like to encourage others to share our approach. In theory, and with help from a supportive IT department, every hospital with EHR should be able to implement our electronic flagging system for teaching purposes. Further work should evaluate the use of our approach in more detail, study perceptions of patients and relatives and consider more innovative ways to use EHR for educational purposes.

Notes On Contributors
Himanshu Singh is a Consultant Respiratory Physician, Year 3 Placement Supervisor and Area Lead at Lancashire Teaching Hospitals NHS Foundation Trust and Associate Year 3 Lead at Manchester Medical School.

Yvonne Thomson was at the time of writing a Year 3 and Year 5 Clinical Placement Facilitator Lead at Lancashire Teaching Hospitals NHS Foundation Trust. She is now a Multi Disciplinary Workforce Coordinator at West Lancashire CCG in Ormskirk, UK.
Madhavi Paladugu is a Consultant Paediatrician and Hospital Dean at Lancashire Teaching Hospitals NHS Foundation Trust.

Nick Wood is Consultant Gynaecologist and Chief Clinical Information Officer at Lancashire Teaching Hospitals NHS Foundation Trust.

Alexander Woywodt is a Consultant Nephrologist and Honorary Clinical Professor in Medicine and Associate Undergraduate Dean for Year 3 at Lancashire Teaching Hospitals NHS Foundation Trust.

HS came up with the idea and progressed it with the hospitals IT department with support from NW as Chief Clinical Information Officer and with support from AW regarding educational governance. HS trialled the approach on his Year 3 undergraduate placement. HS wrote the first concept of the manuscript. AW worked on the manuscript from concept stage to submission with regular input from HS. YT and PM supported the project and provided helpful discussion and comment. AW addressed reviewer comments during the revision process.

All authors have seen and approved the final version of the manuscript.

**Declarations**
The author has declared that there are no conflicts of interest.

**Ethics Statement**
Our study was formally approved by our hospital trusts information technology change board to ensure adherence to information governance, patient safety and confidentiality. It was submitted in writing on Friday 1.4.2016 (change request Nr CR005985) and approved soon after. In our institution this is the type of approval required for the type of study on the trust electronic patient record system described here - an ethics approval was not required. We have provided the journal with a formal letter from our research department dating June 2019 which confirms that in our institution this type of work did not require ethics approval. Verbal consent was obtained from the students who participated in this work. We also obtained verbal consent from all patients who participated in this project in exactly the same way that we would normally ask them for their permission to participate in any other ward-based teaching, such as clinical examination or history taking. This approach to patient consent was also agreed as part of the information technology boards requirements stipulated during the approval process together with the requirement that patients could decide to withdraw at any point in time and without having to provide a specific reason in exactly the same way they can for any other ward-based teaching activity. This option to withdraw was explained to all patients when verbal consent was taken.

**External Funding**
This article has not had any External Funding

**Acknowledgments**
We are grateful to our IT team for technical support and to the students on our Year 3 respiratory placement for trying this out.

**Figure 1.** Source: the author. The image was obtained from our EHR using a fictitious patient and we acknowledge the help and support of our IT team.

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This review has been migrated. The reviewer awarded 5 stars out of 5

Before going ahead, let me say that I have read the Version 2 of this article (not the initial version) where, according to the authors, the changes suggested by previous reviewers were introduced. They are all very pertinent. The authors should be congratulated for this interesting article. Their proposal addresses the lack of ‘systematization’ when teaching occurs in clinical settings, depending only in patients’ availability. This problem, concerning the lack of systematic clinical teaching opportunities, was highlighted already in 1984 by Ronald Harden. In his article Educational Strategies in curriculum development: The SPICES Curriculum, he argues that ‘teaching cannot continue to be left to chance’, i.e. teaching cannot be left to the opportunities that arise in the wards. The use of electronic health records (EHR) to identify good opportunities for clinical teaching is contributing to more ‘systematization’ in clinical settings. According to the authors, good potential opportunities for teaching can easily be identified and planned, avoiding the risk of being lost. In fact, the referencing system allows easy identification of relevant pathologies, facilitating the planning of teaching. I especially appreciated the authors' concern to introduce a system that simultaneously protects the patient from an excessive number of students. This is not only a very important aspect for the patients' well-being but also for students' awareness that patients' well-being must be a priority. Other positive aspects concern the easy transference of this proposal to other educational scenarios and the fact that cost is irrelevant, according to what authors said. There are however two aspects needing attention. One concerns the fact that the use of EHR was tested with only 1 doctor and 8 students. The authors are aware of this limitation, which requires more attention if implementation is to be made with a large number of students. The second relates to the results of Survey Question 6, namely ‘It is easy to track and follow the particular system/pathology patients on ward with the use of the teaching list on QCPR’, which indicate some problems. These problems need clarification because although the authors are aware, they contradict what was reported in terms of easy implementation of the system. To conclude, I would say again that this
is an interesting article that deserves our reading.

**Competing Interests:** No conflicts of interest were disclosed.

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**Reviewer Report 26 March 2020**

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**Subha Ramani**
Harvard Medical School, Brigham and Women's Hospital

This review has been migrated. The reviewer awarded 5 stars out of 5

I read this paper with great interest, being a clinician educator who conducts bedside rounds sometimes purely for teaching purposes. It is very difficult to identify patients for teaching sessions, given the immense volume of traffic (patients, learners, teachers, other staff) as well as ultra short inpatient stays. Clinicians are more often frustrated by switching to EHR practice as it comes with many challenges including increased documentation requirements and information overload. However, we do not often sit down and think about how this information can aid teaching. The authors have done a great job in recommending the use EHR for educational purposes. Methodology is appropriate, writing is very good and recommendations are very useful. They rightly point out the importance of information protection. One point I would like to emphasize is that patients should be informed that their diagnoses will be identifiable and may be used for such teaching sessions at teaching hospitals. We should also avoid crowds of learners coming to talk to or examine the one patient with an interesting diagnosis. This paper is a good start to the discussion and I look forward to further inquiry into this area and recommendations for clinical teaching.

**Competing Interests:** No conflicts of interest were disclosed.

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**Barbara Jennings**
Norwich Medical School

This review has been migrated. The reviewer awarded 4 stars out of 5

Thank you very much for this revised version that has thoroughly addressed the reviewers’ questions and suggestions. Thank you also for a very interesting and well-presented article that presents the use of efficient teaching opportunities linked to the electronic health record. This is an excellent idea for a workplace based educational tool. I think this article will be of broad interest to all colleagues who deliver clinical teaching.

**Competing Interests:** No conflicts of interest were disclosed.

Reviewer Report 24 March 2020

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Trudie Roberts
Leeds Institute of Medical Education

This review has been migrated. The reviewer awarded 4 stars out of 5

As EHRs become ubiquitous it is important that their value as educational tools is recognised and utilised and this paper is a good start in doing this. The discussion is particularly useful in setting out the potential obstacles and how the authors tried to address these issues. As the previous reviewer says the test now will be to scale up this for all students and trainees

**Competing Interests:** No conflicts of interest were disclosed.

Reviewer Report 24 March 2020

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Ken Masters
Sultan Qaboos University
This review has been migrated. The reviewer awarded 5 stars out of 5

The authors have done very well to address the reviewers’ concerns, and have gone further by expanding their Discussion with a broader reflection of practical problems and possible solutions that may confront them as they roll out the system to more students and staff. I look forward to seeing an updated paper detailing the research on a wider scale. Even at this stage, though, I am sure that many readers of this paper will ask their IT support “Why don’t _we_ have something like this?” Nicely done.

**Competing Interests:** No conflicts of interest were disclosed.

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**Version 1**

Reviewer Report 15 October 2019

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Barbara Jennings
Norwich Medical School

This review has been migrated. The reviewer awarded 3 stars out of 5

This is a very interesting article that introduces us to a new educational tool and an approach that has been designed to support undergraduate clinical teaching and learning opportunities. The potential for making the clinical and educational interface more efficient is striking. This approach could also be valuable for clinician CPD in critically important scenarios – such as the identification of rare adverse drug reactions. The rationale for using alerts and tags in electronic health records (EHR) and how the Health Information Exchange Platform can be configured for this task are outlined clearly. The screen shots presented in the methods section are useful illustrations. The integrated nature of the platform that was used in the secondary care setting (with access to laboratory and imaging data as well as primary care records) makes it particularly valuable for this educational application. The authors also carefully describe the information governance and ethical considerations associated with the development of an educational tool from the EHR, and the roles of each author in the project. I have a couple of suggestions and questions for the authors to consider in a revised manuscript, or in further research about the utility of this tool. 1. A more detailed literature review of the validity of this type of educational activity, and the place of EHRs (in undergraduate and postgraduate medical education and assessment) could be useful for the reader. 2. Giving undergraduate students a balanced perspective of both common clinical presentations, and rare but important scenarios is a challenge. Do the authors have any suggestions
about this with respect to this EHR tool? 3. A minor point, I noticed a few typos in the results section of the article. Although this article only presents a preliminary evaluation of the new tool, I think it will be of broad interest to colleagues who deliver clinical teaching - and it is well written and presented.

**Competing Interests:** No conflicts of interest were disclosed.

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**Reviewer Report** 30 September 2019

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**Ken Masters**
Sultan Qaboos University

This review has been migrated. The reviewer awarded 3 stars out of 5

An interesting paper dealing with integrating EHRs into teaching. Some issues need addressing:

• “However to our best knowledge nobody has so far tried to modify EHR systems for educational purposes.” This is a little misleading as many EMR and HER systems do allow areas for student input, and then the organisation can use that input as part of the teaching (e.g. for grand rounds, seminars, etc.) So, unless the authors are using “modify” in a particularly narrow and specifically-defined sense, they may wish to alter or qualify this statement somewhat. (In addition, there is at least one EMR system that is specifically designed for training medical students, so it might be useful to at least refer to that).

• There was a concern about students’ exchanging information. In response, the authors provide a suggestion, but do not actually explain how they attempted to deal with this issue (and the lack of any evaluation (discussed below) does also leave the reader wondering about the effectiveness of the suggestion.).

• Some of the information in Methods (e.g. suggestions and plans) should be moved to later in the paper.

• Although the authors do note the lack of evaluation as a limitation, it really does severely limit the value of the paper. The authors really should have conducted even a basic evaluation to get some sense of the value, otherwise the paper remains in the “nice idea, perhaps” bracket. Perhaps for Version 2 of the paper, the authors will have had the chance to perform some form of rudimentary evaluation.

Minor issues: Some of the paragraphs are really dauntingly long, and could benefit from being broken into smaller pieces. So, an interesting concept, but it would benefit from some more background clarity and some evaluation to get a sense of the viability of the project.

**Competing Interests:** No conflicts of interest were disclosed.

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**Reviewer Report** 10 June 2019
This is a very interesting concept and thank you for sharing your pilot. I would be grateful if you could clarify how the EHR could log how many students have accessed each patient (as suggested in your note "patients who participate repeatedly") or does that mean on multiple admissions? When you roll this out are you planning on including patient feedback?

**Competing Interests:** No conflicts of interest were disclosed.