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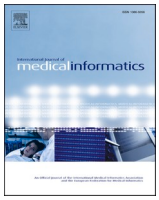
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Integrating interprofessional electronic medical record teaching in preregistration healthcare degrees: A case study

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ABSTRACT

Background: Electronic medical record (EMR) adoption across healthcare necessitates a purposeful curriculum design to prepare graduates for the delivery of safe and effective patient care in digitally-enabled environments.
Objective: To describe the design and development of an Interprofessional Electronic Medical Record (iEMR) subject that introduces healthcare students to its utility in clinical settings.
Methods: A six-stage design-based educational research framework (Focus, Formulation, Contextualisation, Definition, Implementation, Evaluation) was used to instigate the iEMR design and development in nursing and five allied health graduate entry to practice (preregistration) degrees at an Australian university.
Results: In the Focus process, the concept and interdisciplinary partnerships were developed. The Formulation process secured grant support for subject design and development, including a rapid literature review to accommodate various course and curriculum structures. Discipline-specific subject themes were created through the Contextualisation process. During the Definition process, learning objectives and content resources were built. The Implementation process describes the pilot implementation in the nursing program, where assessment tasks were refined, and interdisciplinary clinical case studies originated.
Discussion: The design and development of an iEMR subject is underpinned by internal support for educational innovation and in alignment with digital health strategies in employer organisations. Identified barriers include faculty-level changes in strategic support for teaching innovation, managerial expectations of workload, the scope of work required by academics and learning designers, and the gap between the technology platform required to support online learning and the infrastructure needed to support simulated EMR use. A key discovery was the difficulty of finding EMR software, whether designed for teaching purposes or for clinical use, that could be adapted to meet the needs of this project.
Conclusion: The lessons learned are relevant to educators and learning designers attempting a similar process. Issues remain surrounding the sustainability of the iEMR subject and maintaining academic responsibility for ongoing curriculum management.

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1. Introduction

An electronic medical record (EMR) is 'an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one healthcare organization' [1]. As the use of EMRs in healthcare settings is becoming standard practice, building workforce capability to use core EMR is a priority of national health systems [2,3].

Students in healthcare settings utilize EMRs during clinical placements, but the knowledge and skills required to attain this competency are largely absent in healthcare professions curricula [4]. In addition, depending on the site where students are placed, an EMR might not be adopted yet, or several EMRs might be used concurrently. This inequitable access and variability of limited exposure to EMR during placements mean that many students do not develop the core attributes to practice professionally with them [5], which has implications for the safety and quality of patient care [6,7].

In recent years, education in using EMRs has gained traction in healthcare professions curricula. Several simulated EMR software packages have been developed to teach the clinical applications of EMRs and clinical informatics competencies [8], including Regenstrief Institute's "tEMR" [9], EHR Go [10], SimChart [11] and DocuCare [12], open-source products WorldVista [13] and OpenEMR [14]. The implementation of these software packages in teaching, however, is problematic. Most are unsuitable for interprofessional use because, as practical teaching and learning tools, all must be contextualized in the curriculum of an individual profession [15]. Integrating these resources with university online learning management systems, which have limited flexibility, is also difficult due to different technological and infrastructure requirements. The financial implications of maintaining ongoing subscriptions and administrative issues surrounding accessing student details and data privacy are also challenging. Integrating EMRs into the curriculum of any healthcare profession within a university environment is complex and made more so when considering using them to support interprofessional education and practice [16,17]. This is further hampered by the limited expertise and skill of academics to teach or supervise students to use EMRs [18].

To equip students with essential knowledge and skills in EMRs, educators must create an authentic learning environment that scaffolds learning before, during, and after clinical placements [6,7,19]. Bearing that objective in mind, this paper describes the design and development of an Interprofessional Electronic Medical Records (iEMR) subject that aims to address these challenges and support theoretical and applied learning for students across nursing, optometry, physiotherapy, social work, speech pathology, and audiology at one Australian university.

2. Methods

This case study utilises the Design-Based Research Framework (DBR), which has been applied in various health profession educational technology interventions [20,21]. DBR requires practitioners, designers, and researchers to interact closely. By employing mixed methods to understand the underlying processes and factors, DBR identifies the essential design characteristics for a particular intervention in a specific context and is fruitful when designing or redesigning work-based learning and assessment [22]. When creating technology-enhanced learning environments, such as in this case, DBR is pragmatic, grounded, interactive, iterative, and a flexible, integrative, and contextualized approach [23].

The iEMR project iteratively pursued six major DBR processes adapted from Easterday, Lewis & Gerber [24]. The Results section describes the first five of these processes in full: Focus, Formulation, Contextualization, Definition, and Implementation. Findings from the sixth process, Evaluation, will be reported in a separate paper to describe the pilot implementation in the nursing program. Four propositions were tested about this educational intervention: 1) academic and professional leadership can be mobilized to support integrating an EMR into the curriculum; 2) in-house expertise is capable of developing relevant teaching and learning resources and assessments; 3) the subject can offer flexibility of being adopted as a stand-alone subject, or particular aspects of it can be embedded within existing subjects; 4) the subject can be effective in equipping students with essential capabilities needed for professional practice. The Discussion section reflects on the extent to which the project has borne out propositions 1) and 2) so far and how further Implementation and Evaluation may provide further insight into 3) and 4).

3. Results

3.1. Focus process

3.1.1. Bringing the project into focus

The project lead (ZLT) was part of a hospital EMR rollout and a proficient user of EMRs in clinical and research practice before joining the university as a nursing course coordinator (program director) in a multidisciplinary School of Health Sciences. To prepare preregistration graduate healthcare students to work in a digitally-enabled healthcare environment, the investigator reached out to senior management to advocate implementing a digital health curriculum, starting with EMR teaching and learning. This advocacy led to meetings with a university health informatics and digital health expert (KG). Subsequent discussions resulted in further development of the idea, including project resourcing options and that broader partnerships across health profession disciplines are essential to realize the concept.

3.1.2. Forming the interdisciplinary team and (2) plan

When the university called for applications for competitive grants to support the development of online subjects in 2019 (AUD$20,000 for School academics' time release and AUD$20,000 for centrally sourced learning design services), ZLT contacted each course coordinator in the school to propose the idea of an interprofessional EMR subject. There was strong support, with two representatives from entry to practice degrees in nursing, physiotherapy, speech pathology, audiology, and social work, and one from optometry attending an initial team meeting. This meeting was also attended by the School's Director of Learning and Teaching, the School Manager, and a faculty-level Diversity and Inclusion Committee member. At this meeting, ZLT outlined Australia's national digital health strategy [2], noted existing and pertinent degree accreditation requirements for nursing and physiotherapy, shared own workplace experience with using EMRs, and outlined the vision for the EMR subject – introductory content, inclusive of interprofessional practice, incorporating clinical simulation, and flexible delivery. All disciplines' representatives supported the concept and agreed to be part of the grant application team.

3.2. Formulation process

The lead investigator (ZLT) undertook a rapid literature review under the health informatics and digital health expert (KG) mentorship. The lead investigator drafted the grant proposal and secured input from all investigators and support from all discipline heads. The team was funded from May 2019 to December 2020 to create a 6.25 credit point online subject (one-eighth of an entire semester of study) named Interprofessional Electronic Medical Records (iEMR). The team met monthly to plan and review progress, and the health informatics expert provided advice and guidance. Two centrally-sourced learning designers engaged with the team and worked to understand the needs of all disciplines, including aligning with the accrediting body requirements and the national digital health strategy. The learning designers facilitated subject development using a rapid instructional design model consisting of four stages - preparation, presentation, practice and performance [25]. Together with the lead investigator, the learning designers incorporated

the online learning component of the project into the university's Canvas™ learning management system.

3.3. Contextualization process

3.3.1. Contextualizing the pedagogy

The themes identified for the iEMR subject were underpinned by Pontefract and Wilson's study [26]. In that study, a national working group was established to integrate electronic patient records (EPRs) into undergraduate education for healthcare students studying medicine, pharmacy, nursing, and midwifery in the United Kingdom. Representatives from 12 academic institutions, the National Health Service, and EPR system providers proposed six domains of learning outcomes: 1) adopting digital health: working as a practitioner in the digital healthcare environment; 2) accessing data: accessing and interpreting patient data to inform clinical decision-making; 3) communicating: communicate effectively with healthcare professionals and patients in the digital environment; 4) generating data: generate data for and about patients within the EPR; 5) multidisciplinary working: work with healthcare professionals with and alongside EPRs; and 6) monitoring and audit: monitor and improve the quality and safety of a digital healthcare from Pontefract and Wilson [26].

Keeping the above themes in mind (Fig. 1), the team considered and compared each profession's scope of practice and graduate attributes. For example, in nursing, the scope of practice is defined as 'that in which nurses are educated, competent to perform and permitted by law. The actual scope of practice is influenced by the context in which the nurse practises, the health needs of people, the level of competence and confidence of the nurse and the policy requirements of the service provider.' [27]. In physiotherapy, it is defined as: 'the professional role and services that an individual health practitioner is trained, qualified and competent to perform.' [28]. The team had to consider what the scope of practice means in the context of EMR. For this purpose, the team engaged with clinical partners to map out what this may mean for a graduate. Once the team understood each profession's scope of practice, the digital health themes from [26] were refined until consensus was reached.

3.4. Definition process

3.4.1. Defining the learning objectives, activities, and resources

The team participated in two workshops facilitated by the senior learning designer to develop the learning objectives (Table 1) and to structure the activities, content, tasks, and resources to meet these objectives. An online subject planning template allowed interactions with the learning designers and enabled interdisciplinary input and asynchronous peer review from each discipline.

The resulting iEMR subject comprises six modules with theoretical

Table 1
The iEMR Subject Intended Learning Outcomes (SILOs) mapped to cognitive domains according to Bloom's taxonomy [29].

Subject intended learning outcomes (SILOs)	Cognitive domains, according to Bloom's taxonomy
SILO 1: Identify the functions of EMR in a range of healthcare settings and contexts	Knowledge
SILO 2: Interpret EMR data for effective interdisciplinary communication	Comprehension
SILO 3: Enter quality data into EMR in person-centred models of care	Application
SILO 4: Critique the nature and quality of EMR data available for specific cases of patient/client management and support, healthcare service planning, and clinical research	Analysis

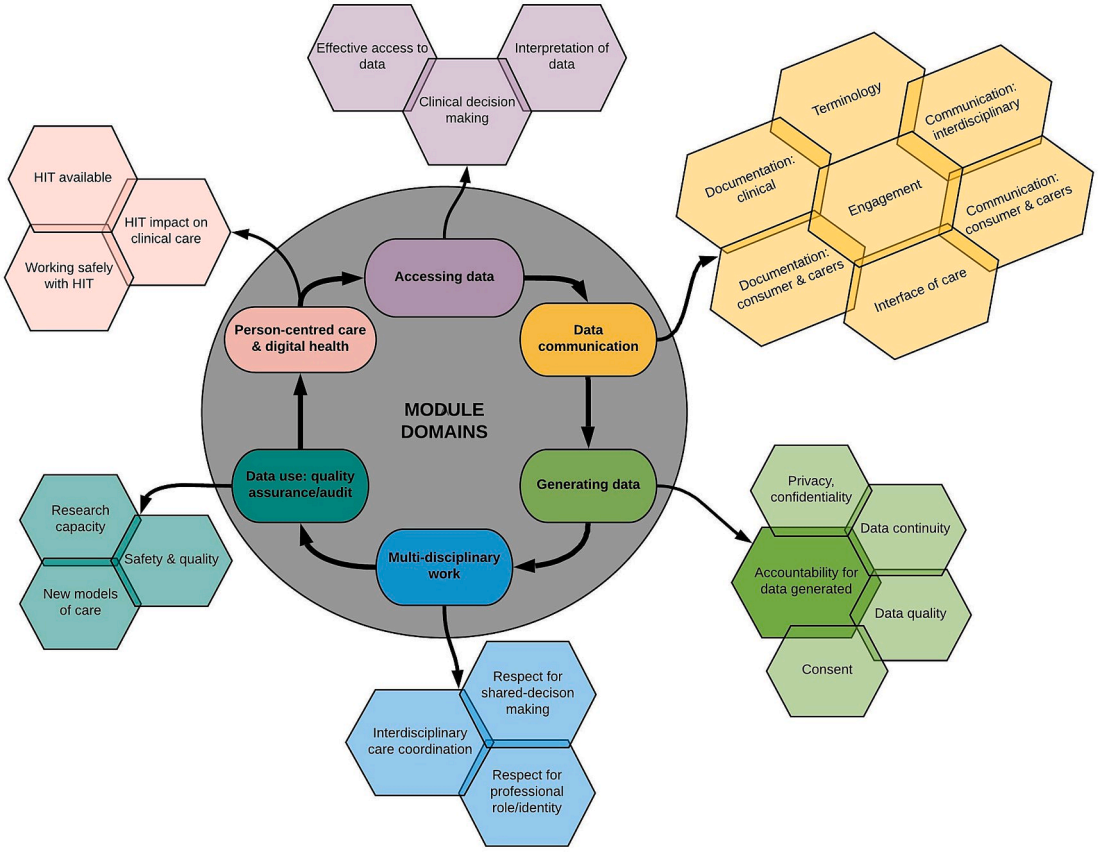


Fig. 1. Themes and domains of competence.

and practical components. They are: 1) Person-centred care in the age of digital technology and introduction to EMR software; 2) Generating and recording the data: patient data collection and entry into an EMR; 3) Accessing and interpreting patient data to inform clinical decision-making; 4) Communicating data: effective interdisciplinary communication with various stakeholders (e.g., consumers, healthcare service planners) in the presence of EMR; 5) Management of the data within an EMR: how can we trust the data that we and others have entered in the EMR; 6) Analyzing EMR data: EMR as a research tool, auditing and quality and safety in healthcare. Table 2 presents the associated themes and subtopics, and learning outcomes linked to the subject's intended learning outcomes defined in Table 1.

The iEMR subject has a theoretical component common to all disciplines. One could adopt a weekly study of one module over six weeks, or modules can be studied sequentially in a time frame that suits a specific degree. Each module takes approximately-one hour of independent study to complete, consisting of text and graphics, self-tests, discussion topics, and links to further readings and resources. Modules are accompanied by ten interdisciplinary clinical cases developed using an iterative process: Initially, each team member submitted a case specific to their discipline. Subsequently, other team members accessed the case and added a discipline-specific component. An example of a case is shown in Fig. 2.

The iEMR subject's practical component can be implemented as needed by each discipline over timeframes ranging from one to two hours per week. Using low to medium fidelity simulation, students can work with the clinical case studies synchronously or asynchronously [30]. A low fidelity template in Canvas™ can be used to enter clinical notes in the EMR. The support for interprofessional education is illustrated here - for example, a nursing student could note a patient's mobility issue and use the EMR to refer to physiotherapy, or a physiotherapy student could refer a wet wound dressing to nursing. Where the EMR was integrated into the clinical simulation component of the curriculum, nursing and physiotherapy students had access to additional software via workstations on wheels in a simulated laboratory suited to their professional context (medium fidelity).

This approach to practical learning was the consequence of extensive efforts to identify EMR software suitable for the iEMR subject, noting that the university grant did not fund this specialised form of educational technology support. The teaching of the EMR needed to reflect the Australian healthcare system, so the team used characteristics defined by the state department of health [31] and Wilbanks et al. [32] as a starting guide to describe the desired features. Furthermore, the team needed an EMR that enabled educators to upload the marking rubric to provide effective student feedback. Assessments involving the use of teaching concepts of EMR needed to integrate with the university information technology systems, particularly the Canvas™ online learning management system, and be usable on multiple platforms, including mobile devices and desktops. Supplementary File 1 describes the search process for a suitable teaching EMR for Australian interdisciplinary use.

3.4.2. *Defining assessments*

For assessment, students were expected to complete four EMR entries on cases of increasing clinical complexity (Table 3). Each EMR entry was worth 10 % of the mark for this subject. In addition to these regular EMR entries, students were required to review and audit simulated EMR entries created by the team and provide critical data analysis. This analysis was worth 30 % of the mark. As a final assessment, students analyzed a critical incident where some aspect of EMR data had compromised the quality and safety of patient care. This analysis was worth a further 30 % of the mark. The assessment volume was estimated as equivalent to 5000 words, keeping with university policy on coursework.

3.4.3. *Subject review*

Peer and stakeholder review was conducted on all subject learning objectives, activities, resources, and assessments. The draft iEMR subject

Table 2
iEMR subject outline. Abbreviations: SILO = Subject Intended Learning Outcome.

Module	Themes and sub-themes	Module learning outcomes mapped to SILO
One	Person-centred care in the age of digital technology • Introduction • What is an EMR? • Person-centred care • The EMR and person-centred care • Health literacy and digital literacy • Digitised health: risks and limitations	1. Identify evidence of person-centred care in EMR (SILO 1 and 2) 2. Access and navigate the EMR simulation environment, and identify the case study areas (SILO 1) 3. Record data in EMR from specific case studies (SILO 2) 4. Outline the risks and benefits of digitisation of patient records for patients and their carers and healthcare staff, and the potential limitations of EMR systems (SILO 1)
Two	Generating and recording data: patient data collection and entry into an EMR • Introduction • Data collection, entry and evaluation • Which data is necessary • Patient safety and quality of care • Data quality • Data standardisation	1. Generate data efficiently and proficiently, including relevant, complete, and necessary data for diagnosis, management, treatment, and adverse events. (SILO 2) 2. Recognize good practice within the EMR environment, including respect for patient consent, privacy, and confidentiality when generating data. (SILO 2 and 4)
Three	Accessing and interpreting patient data to inform clinical decision-making • Introduction • Electronic medication management • EMR speciality applications • EMR clinical decision support	1. Access electronic data within a simulation setting to retrieve relevant data to plan care whilst maintaining patient consent, privacy, and confidentiality. (SILO 3) 2. Assess the accuracy of data and identify gaps to determine the completeness of documentation. (SILO3) 3. Plan and review clinical care and make decisions with reference to electronic data accessed within the EMR. (SILO 3 and 4)
Four	Communicating data: effective interdisciplinary communication with various stakeholders in the presence of an EMR • Introduction • The concept of the e-patient • Patients' use of self-related health data • Impact of e-patients on clinical practice • Identifying good and bad practice	1. Communicate effectively with the appropriate healthcare professionals in the electronic environment when required. (SILO 3) 2. Maintain patient communication and patient engagement when using the EMR system. (SILO 3) 3. Document information relating to the management of patients using appropriate language for patients and their carers. (SILO 2)
Five	Management of data within an EMR: how can we trust the data that we and others have entered into the record • Introduction • Transparency and access to data • Legislative and policy influences in managing access to data • Cyber security • Who owns the EMR data	1. Apply appropriate security protocols in the management of patient data. (SILO 2) 2. Discuss ownership of electronic medical records and patient data. (SILO2) 3. Explain the importance of information governance and data protection in the context of an EMR. (SILO 2)
Six	Analyzing the data: EMR as a research tool: auditing and safety of healthcare quality and nature • Introduction	1. Identify the effects of poor data entry/documentation and use patient and clinical data to support monitoring and audit

(*continued on next page*)

Table 2 (*continued*)

Module	Themes and sub-themes	Module learning outcomes mapped to SILO
	• EMR as a research tool • Core components of an EMR to facilitate research activities • Large scale data and evidence-based quality improvements • Large scale data and improvements in patient care	for quality improvement. (SILO 4) 2. Describe the role of an EMR in identifying suitable patients for recruitment for ethically approved research studies. (SILO 1)

was published in Canvas™ for review by digital health experts (n = 2), hospital-based EMR trainers (n = 2), and student users (n = 7). Digital health experts were asked to align the content with fundamental health informatics concepts. Hospital-based super-users were asked to comment on content and assessment to reflect real-life needs. Final year students from nursing (n = 4), social work (n = 2) and physiotherapy (n = 1), who were trained in hospital EMRs during clinical placements, provided feedback and recommendations from their perspectives as novice learners. A diversity and inclusion academic specialist reviewed all content to ensure it observed appropriate cultural safety practices.

3.5. Implementation process

The team decided that the implementation of iEMR should occur as early as possible in entry-to-practice degrees. Each discipline would implement the subject as appropriate in their program of study (Table 4), however, all implementations would occur before a student's first clinical placement.

A pilot of the iEMR subject with Master of Nursing Science students, coordinated by ZLT, occurred in the first half of 2021. The team identified how to introduce EMR while introducing students to collecting patient histories and appropriate documentation. This was followed by the clinical assessment of different body systems and the need to manage data entries gained through the increasing scope of practice. Lastly, students collected related assessment data, made beginner-level clinical decisions, and documented these processes. Overall, the iEMR subject reflected clinical processes from clinical assessment (data gathering), documentation (data entry), data storage (databases), and interdisciplinary healthcare planning (data communication) to understanding the value of quality data (research) to deliver evidence-based healthcare.

This pilot study also considered social, teaching and cognitive presence in the delivery of the unit. For example:

A 30-minute staff presentation on the designated topic for that week was delivered via audio.

Self-assessment of topic understanding: each weekly topic was accompanied by a 10-question multiple-choice quiz. These were available on-demand and based on deriving questions randomly from the question bank with feedback provided in real-time.

Students received EMR training in face-to-face simulation classes, and during simulation laboratory open hours could freely access workstations on wheels to develop skills in using EMR.

Students received clinical case studies to document in EMR each week. Tutors were tasked to review these entries and provide feedback using a marking rubric.

Students participated in bi-weekly interdisciplinary clinical meetings with the tutor via videoconference to review real-life scenarios and associated EMR data to plan interdisciplinary care. Students received real-time feedback from their tutors during these meetings, which prepared students to undertake a review of interdisciplinary EMR entries for assessment.

Students participated in a bi-weekly community of inquiry online discussion forums moderated by the tutors to self-reflect on EMR

Table 3
iEMR Assessment Components.

Task	Timing	Alignment to SILOs	% of the total mark
Clinical case-note entries to EMR	Modules 2–5 (4 entries worth 10 % each)	SILO 1 and 3	40
Review of interdisciplinary EMR entries	Module 6	SILO 2 and 4	30
EMR data critical incident analysis	Module 6	SILO 2 and 4	30

Table 4
Intended implementation of the iEMR subject into degree programs.

Degree	Occurrence in the program of study	Stand-alone or integrated
Master of Nursing Science	Year One, Semester One	Integrated
Master of Social Work	Year One, Semester One	Integrated
Master of Speech Pathology and Audiology	Year One, Semester Two	Integrated
Doctor of Optometry	Year Two, Semester One	Integrated
Doctor of Physiotherapy	Year One, Semester Two	Integrated

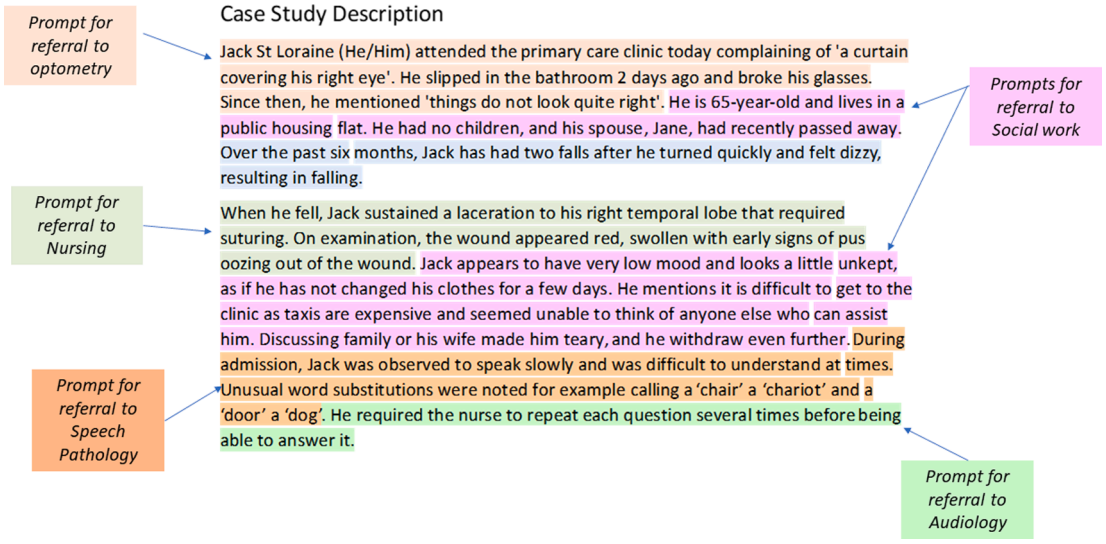


Fig. 2. An example of interprofessional clinical case study used in iEMR.

applications and the impact of EMR on the scope of professional practice.

In addition to the curriculum development and approval process resourced by the university teaching and learning service, it was also necessary for the project lead to develop a business plan in conjunction with a project manager from the university business development unit. The plan (Table 5) itemized and costed the work to establish and maintain education technology upgrades to the existing 20-bed clinical simulation laboratory and introduce workstations on wheels where students could work with simulated EMR. The plan also included installing these workstations and an EMR software product called Best Practice™, a widely used EMR in primary and community healthcare in Australia. The decision to trial this software for education purposes was that the software was already licensed for research use elsewhere in the university (in connection with a database of general practice data for secondary use) and reflected authentic interprofessional clinical settings. After multilateral negotiations, it was agreed that this license could extend to teaching use for a trial period of one year on 20 workstations.

3.6. Evaluation process

The next stage for the iEMR subject will be to evaluate the impact of the pilot implementation following the principles of Kirkpatrick's Four Levels of Training Evaluation [22,24]. Here, the intent is to measure four components. The reaction will be measured using a modified version of the university subject experience survey. Learning will be measured using pre-post validated questionnaires that assess student competency in working with EMR. The behaviour will be gauged in focus groups to determine student perceptions of what worked and did not work. Results will be gauged through longitudinal follow-up interviews with graduates and employers to explore how the iEMR subject reflected the realities of clinical environments and whether students could apply what they learned in those settings.

4. Discussion

The iEMR was designed to teach students EMR skills using real-life clinical scenarios and resources. During the design, it was necessary to continuously reflect on the learning objectives and prepare content so that it could serve the needs of all participating disciplines. The interprofessional vision meant that many negotiations occurred in each module so that each discipline could employ the modules they felt were most needed in their program. In the longer term, as separate health professions determine their distinctive digital scopes of practice, the interdisciplinary approach of the iEMR subject may bear up or grow into more customized educational offerings.

Implementing pedagogically driven EMR practice aimed to introduce healthcare students to using an EMR to collect data, facilitate interprofessional and person-centred communication, and develop fundamental skills in using EMR data to make evidence-based clinical decisions. Purposeful introduction of the iEMR subject early in the structure of an entry-to-practice degree can provide beneficial exposure of healthcare students to best practice in using an EMR before they undertake work-integrated practice or clinical placements - where students are likely to observe suboptimal practices and may be inclined to adopt those [33,34]. The following implementation step for this project is to develop sustainable EMR simulation training throughout all healthcare degrees to consolidate the theoretical learning in the iEMR subject.

The work presented in this paper was supported by a university's learning and teaching grant to encourage flexible and innovative education. The innovation proposed in the iEMR subject, however, entailed extensive efforts beyond the university's online learning platforms and services. It was necessary to extend the capabilities of a conventional clinical simulation laboratory to enable the simulated use of EMR in that setting. Working out appropriate and affordable educational technology infrastructure for the practical component of the iEMR subject remains a work in progress.

The academic team consider that comprehensive preparation in some of the foundations of clinical informatics, such as the iEMR subject offers, is a solid way to build a digitally enabled health workforce. In this, they are supported by the national digital health workforce strategy and by the university's digital health experts. On the other hand, some clinical placement providers believe that in-house clinic-based training is sufficient to equip new graduates with necessary EMR skills. Unresolved differences in perspectives remain between academic educators and clinical placement providers about what the iEMR subject will achieve in terms of workplace impact and how much priority it should have in the curriculum. Other identified barriers included faculty-level changes in strategic support for teaching innovation, managerial expectations of workload, the scope of work required by academics and learning designers, and the gap between the technology platform required to support online learning and the infrastructure needed to support simulated EMR use.

Compared to prior work in implementing EMRs into the curriculum, it is noteworthy that several studies have described the implementation of the EMR into their course offerings [35–38]. However, many studies lack the bolts and nuts of the implementation process. To the best of our knowledge, this paper is the first to describe the detailed development and implementation plan of an interprofessional EMR subject that can be run independently or integrated into existing subjects. It is unique in the experience it outlines in working out assessments that are aligned with subject learning outcomes and in the educational technology infrastructure aspects of the associated implementation process.

Concerning limitations, the iEMR subject requires an evaluation from user experience perspectives. For example, while social presence is promoted via virtual interdisciplinary clinics and an online discussion board, it remains to be determined whether proposed learning activities and assessments are sufficiently varied and flexible to meet the needs of students from diverse backgrounds. Therefore, the intention is to interview students and staff involved in the teaching and learning of iEMR to assess this resources' value, impact, and quality. Another limitation is that there is no baseline information regarding the student

Table 5
Business plan for the implementation of the iEMR subject practical component.

Item	Cost estimates	Comments
EMR license	Leveraged existing university license for research; ongoing costs to be determined.	Not designed for academic purposes; however Australian-specific software with real-world relevance.
Workstations on wheels (WOWs)	AUD$ 4000 per workstation on wheels (WOWs) × 20 WOWs = AUD$ 80 000.	This provides one WOW per bed in the clinical simulation lab, including batteries and chargers.
Staff training to use EMR and WOWs	Ten staff members × AUD$ 250 = AUD$ 2500.	Critical team to be trained, then training off-site.
Creating simulated patient records to work within the EMR database	Estimate for 100 patient records AUD$ 50,000.	Once data is extracted in some structured format from various possible sources, a technician needs to convert the data into patient record XML and pathology lab XML. A software utility is needed to be able to restore the Best Practice™ database from backup so that each new class can work with uncontaminated, updated and re-imported data.

cohort's digital literacy, health literacy, or previous exposure to EMR in the hospital settings and how this impacts their experience of iEMR. These can be addressed, however, by conducting a baseline digital and health literacy assessment before starting the subject [39]. Any deficits can be remediated using university's student learning skills services to help bridge the gap in digital practices [40] and foster positive attitudes to digital health technologies [41].

5. Conclusion

This case study described the implementation of an interprofessional EMR in healthcare degrees with a pedagogical framework, including how an EMR tool was selected for academic purposes, the plan to evaluate it, and what to consider when implementing academic versions of an EMR. This work was challenging and required substantial support from academic, management, and business operations people. The work can progress, however, where there is a vision that through educating healthcare students on best practice in using EMR, it will lead to positive patient outcomes and facilitate student transitions to full employment in digitally-enabled healthcare systems.

Author contributions

The initial project idea was conceived and managed by ZLT. All authors then contributed to the refinement of the idea, scoping review process and to the formal analysis of the results. ZLT drafted the first version of the manuscript. All authors contributed to discussions on the direction of the scoping review, and subsequent manuscript revisions and all agreed to the final manuscript version.

CRediT authorship contribution statement

Zerina Lokmic-Tomkins: Conceptualization, Methodology, Formal analysis, Resources, Writing – original draft, Writing – review & editing, Project administration, Funding acquisition. **Kathleen Gray:** Conceptualization, Methodology, Formal analysis, Resources, Writing – original draft, Writing – review & editing, Project administration, Funding acquisition. **Lisa Cheshire:** Conceptualization, Formal analysis, Resources, Writing – review & editing. **Arno Parolini:** Conceptualization, Methodology, Formal analysis, Resources, Writing – review & editing, Funding acquisition. **Megan Sharp:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Funding acquisition. **Bronwyn Tarrant:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Funding acquisition. **Nicole Hill:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Funding acquisition. **David Rose:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Funding acquisition. **Marilyn Webster:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Funding acquisition. **Debra Virtue:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Funding acquisition. **Amanda Brignell:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Funding acquisition. **Rebecca Waring:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Funding acquisition. **Fiona Broussard:** Methodology, Formal analysis, Resources, Writing – review & editing. **Alex Tsirgialos:** Methodology, Formal analysis, Resources, Writing – review & editing. **Kwang Meng Cham:** Conceptualization, Methodology, Formal analysis, Resources, Writing – review & editing, Funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijmedinf.2022.104910.

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