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Woman-centred care and integrated electronic medical records within Australian maternity settings: Point prevalence audit and observational study

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ABSTRACT

Objective: Transition to paperless records brings new challenges to midwifery practice across the continuum of woman-centred care. There is limited and conflicting evidence on the relative benefits of electronic medical records in maternity settings. This article aims to inform the use of integrative electronic medical records within the maternity services' environment with attention to the midwife-woman relationship.

Design: This descriptive two-part study includes 1) an audit of electronic records in the early period following implementation (2-time points); and 2) an observational study to observe midwives' practice relating to electronic record use.

Setting: Two regional tertiary public hospitals

Participants: Midwives providing care for childbearing women across antenatal, intrapartum and postnatal areas.

Findings: 400 integrated electronic medical records were audited for completeness. Most fields had high levels of complete data in the correct location. However, between time 1 (T1) and time 2 (T2), persistent missing data (foetal heart rate documented 30 minutely T1 36%; T2 42%), and incomplete or incorrectly located data (pathology results T1:63%; T2 54%; perineal repair T1 60%; T2 46%) were identified. Observationally, midwives were actively engaged with the integrative electronic medical record between 23% to 68% (median 46%; IQR 16) of the time.

Conclusion: Midwives spent a significant amount of time completing documentation during clinical episodes of care. Largely, this documentation was found to be accurate, yet exceptions to data completeness, precision and location remained, indicating some concerns with software usability.

Implications for practice: Time-intensive monitoring and documentation may hinder woman-centred midwifery care.

Introduction

Contemporary midwifery practice is based on a philosophy of woman-centred care. Identified core concepts of woman-centred care are the women's sphere, holism, self-determination and shared power relationship as articulated in the Woman Centred Care Scale (Brady et al., 2017). This partnership approach to care involves the health professional (in this case the midwife) initiating a partnership in care with each woman, sharing information

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and decision-making (working the partnership), and safeguarding the partnership through documentation (Ekman et al., 2011; Kerkin et al., 2018). The quality of this documentation is important for point of care decision-making throughout pregnancy and the puerperium, and critical decision-making during childbirth. Transition to paperless records brings new challenges to midwifery practice, known for shared care, maternal hand-held records, and midwifery-led practice (Hawley et al., 2014).

Evaluative research regarding the use of Information Communication Technologies (ICT) (Dalton et al., 2014), mHealth, social media (Gleeson et al., 2018; Gleeson et al., 2021), and applications (Hughson et al., 2018) in maternity settings are increasingly published in contemporary midwifery literature. Reported benefits of ICT include accessible, legible, mineable data (Eden et al., 2020; Sarwar et al., 2022; Wynter et al., 2021) while challenges include loss of individuality through standardisation, documentation burden (Dalton et al., 2014), reduced autonomy through the loss of a woman's control of their records (Hawley et al., 2017) and threats to data security (Shenoy and Appel, 2017; Wilson et al., 2017). Electronic medical records (EMR) provide a rich source of data that can be mined for evidence to underpin evolving practice and address disparities in provision of quality maternity care (Jean-Francois et al., 2021). This goal has been cited as a primary reason for health service adoption of the move from paper to digital records in addition to other reasons such as patient safety including the ability to monitor health system performance and quality indicators (Australian Institute of Health Welfare, 2020; Jean-Francois et al., 2021; Perez-Stable et al., 2019; Wakefield et al., 2021).

Digitalisation of traditionally paper medical records in acute hospital settings is occurring internationally. The technology has been forecast to improve legibility, timeliness and access by multiple clinicians (Eden et al., 2020; Wynter et al., 2021). Evidence from systematic reviews and meta-analyses however, have shown mixed and conflicting results (Keasberry et al., 2017) ranging from having no impact on mortality, length of stay and costs (Thompson et al., 2015) to reducing admissions to hospital, length of hospital stay and the number of patient visits to emergency departments (Health Quality, 2013). Of the benefits to be gained by EMR implementation, the potential for improving health outcomes through improved patient safety provides a fundamental incentive (Otieno et al., 2008). Equally important is the opportunity to use the data to improve care and subsequently health outcomes for women and their babies.

Despite the benefits identified, electronic documentation in midwifery settings holds unique challenges. Midwives routinely capture data for both women and infants, thus their cognitive workload is increased (Wynter et al., 2021). Documentation burden arising from EMR has been defined in recent literature (Moy et al., 2021) and linked to medical error, patient safety, poor quality documentation, and burnout (Dalton et al., 2014; Gesner et al., 2019). Other studies report that participants (both nurses and midwives) perceived clinicians were more accountable, because every action in the electronic medical record is associated with a particular clinician (Wynter et al., 2021). Issues with burnout impact patient safety, however, much of this research has been done with medical professionals (Gesner et al., 2019; Moy et al., 2021). The data available in maternity settings and/or including midwives is either scant or included with nurses' responses (Wynter et al., 2021). What little is known includes divergent levels of technology acceptance by midwives because of the perceived shift from a traditional focus on care for the mother and baby (Brunelli et al., 2021; Craswell et al., 2015; Hammond et al., 2013).

High income countries from the Organisation for Economic Co-operation and Development (OECD) such as the United Kingdom (UK), the United States of America and Australia aim to create interoperable maternity records for women. The National Health Service in the UK is coordinating the Women's Digital Care Records project to support women to contribute to their record to provide clinicians with a greater understanding and positively impact care (NHS Digital, 2020). The National Digital Health Collaborative in Australia is trialling a Digital Pregnancy Health Record (Antenatal Record) at one site in Queensland (Children's Health Queensland Hospital and Health Service, 2021). This aims to reimagine the successful paper handheld record so women can store and share their pregnancy health information with their healthcare providers anytime, anywhere in Australia (Children's Health Queensland Hospital and Health Service, 2021).

It is well recognised that effective clinical decision-making within maternity settings results in improved health outcomes for mother and baby including reduced morbidity and mortality (Tunçalp et al., 2015). It is suggested that the use of EMRs improves patient safety through enhanced quality of record keeping, improved continuity of care and communication between different providers (Usmanova et al., 2021). However, evidence of the effects of the EMR on outcomes such as morbid events, mortality and readmissions is limited and conflicting (Keasberry et al., 2017). Studies examining perceptions also have conflicting results. Research examining nurses' perspectives (Kossman and Scheidenhelm, 2008) found that although they felt EMRs enabled them to provide safer care, the technology decreased the quality of care. Similarly, Hawley et al. (2014) observed that midwives thought the EMR was a more advantageous way to document and retrieve data, yet diminished interaction and engagement with the women, fundamental to effective and safe midwifery care.

In the State of Queensland, Australia, the integrated electronic medical record (ieMR, Cerner) was trialled at a large metropolitan hospital before being rolled out sequentially across public hospitals throughout the state. Importantly, the trial hospital did not have a maternity service. As a result, ieMR implementation for maternity did not benefit from the trial and subsequent recognition and management of issues until wider implementation. This, in combination with the limited and conflicting evidence on the successful use of EMR in maternity settings is concerning. This article presents findings from a multi-site study observing the interaction between midwives and childbearing women and the auditing of documentation following the implementation of the Cerner ieMR into tertiary maternity settings.

Methods

Design

This descriptive multi-method study used documentation audit and observation. This design aimed to determine potential areas of conflict in the data in the electronic medical record and observe midwifery practice to examine the setting in which data was entered. It was hoped the observation would provide new knowledge on the impact of data entry on practice and better understand potential conflict in the data entered.

Aim and objectives

The overall aim of this study was to inform the use of the ieMR within maternity service environments. Specific objectives addressed within this study were to:

1 Compare the completeness of electronic medical records during the early introductory phase and once embedded within clinical care
2 To observe the impact of the ieMR on midwives' decision-making and practice, autonomy and relationship with the

woman being cared for within antenatal, birthing, and postnatal environments

The decision to view the data at two time points, post complete ieMR implementation, aimed to account for adoption of the new technology as described in the Theory of Diffusion of Innovations (Rogers, 1995) and give a more pragmatic view of the use of ieMR in the maternity setting. This article presents data from phases one and two of a broader program of research to understand and describe the impact of ieMR on selected aspects of midwifery care.

Setting

This study was conducted across two regional hospitals in Queensland, Australia. Both sites offered tertiary maternity care and were public facilities. Site one had approximately 2400 births per annum and transitioned from paper records for women and babies to ieMR in August 2016, completed in July 2019 when the electronic medication administration records were added. Site two had approximately 3200 per annum at the time of this study and finalised transition to ieMR from paper charts for mother and baby in March 2019. Prior to implementation of the ieMR, all staff received three full days of training in the use of the ieMR and staff were provided support 24 h/day, 7 days/week during the first 3-months of implementation with experienced staff (without a clinical load) available to assist.

Phase 1: point *prevalence audit of records*

Records of women receiving antenatal, intrapartum or postnatal care were audited on two days nominated for data collection at two time points post complete ieMR implementation (Site 1, 100 records January 2019 and 100 records February 2020; Site 2, 100 records September 2019 and 100 records March 2020). This convenience sample was determined based on a population of daily occasions of service at Site 1, 266 and Site 2, 386, with a confidence level of 95%.

Phase 1: Data collection

Meetings to identify areas of inconsistent and problematic documentation were undertaken with clinical stakeholders including the Midwifery Unit Managers, Clinical Midwifery Consultants and experienced midwives from birth suite and antenatal clinic settings at both sites. The variables of interest were a selection of mandatory and non-mandatory fields, some from those already collected for State-wide mandatory Perinatal Data Collection, including:

- Pregnancy history (including pre-existing and conditions arising during pregnancy)
- Infant feeding history and plan
- Allergies, current medications and history of anaesthesia, sedation, and blood transfusion
- Tobacco, alcohol and other drug screening
- Perinatal mental health screening
- Model of care and birth plan
- Pathology and medical imaging documentation
- Intrapartum clinical practice (including abdominal palpation, frequency and type of foetal heart rate auscultation, placental location, onset of labour and stages of labour, medication administration, perineal trauma, and newborn birth information)
- Postnatal routine midwifery assessment

Records were reviewed independently by two clinical investigators (MH, RC) at each site (familiar with ieMR and local protocols for where data should be entered) and data items were categorised as: documented, not documented, incomplete documentation, documented in an alternate location, incorrectly documented, and other. Both investigators entered 10 charts (five from each site) and checked for similarity, discussed any discrepancies, and then made clear notes for each data item and category to remove ambiguity. After a further 25 charts were reviewed, investigators met to discuss and clarify any possible areas of difference/confusion that remained. The remaining charts were audited, half by each of the clinical investigators.

Phase 1: data *analysis*

Data were extracted from individual records and entered directly into a pre-designed Excel spreadsheet, coded, and cleaned. Exploratory analyses were performed to investigate the distribution, summary statistics and relationships between the variables of interest. Categorical variables are presented using frequencies and proportions. We performed Chi-square tests to investigate associations between time 1 and time 2 data collection and categorical variables (e.g., medications and allergy documentation). All analyses were performed in SPSS Version 26 (IBM Corp., Armonk, NY).

Phase 2: observational *study of midwives' practice*

An exploration of the behaviour and interactions between midwives, women receiving perinatal care and the technology used for documentation was made in this phase. The use of non-intrusive observation allowed for in-depth interpretation of the prevailing culture through the immersion of the research midwives within the clinical settings. Participants were midwives providing clinical care to childbearing women across the continuum of care at both sites. Women were classified as third-party non-participants in keeping with ethical guidelines (National Health and Medical Research Council, 2007). Women were informed of the study and verbally consented for the observer to be in the room but no data was collected from or about them. Convenience sampling was employed, with a total of 16 midwives from site 1 and 29 midwives from site 2, consenting to be observed.

Phase 2: data *collection*

The phenomenon of interest was the practice of the midwife and the nature of the interaction between the midwife and the woman, relative to the use of the ieMR. This study aimed to provide a deeper understanding and explanation of the findings from the point prevalence audit. Observation was undertaken between September 2020 and January 2021 by two research midwives. Data were collected by way of detailed field notes including time stamps for every action taken by the midwife involving the ieMR. The observer midwives were known to the staff at both sites as expert ieMR users and able to assist if they were having difficulty. No midwives declined to be observed. Additionally, data were gathered on where in the ieMR information was stored by the midwife, where information were sourced, and any workarounds used by the midwife as a part of daily work with the ieMR. Approximately 50 h of observation between antenatal, birthing, and postnatal care settings was completed in total across both sites. Midwife observers from each site shared early observation data sheets and discussed methods of observation to maintain consistency.

Phase 2: Data analysis

Field notes taken during the periods of observation were analysed by two authors who had collected the data (AC, MH). Descriptive analysis of the data was used to quantify time spent on ieMR and qualify activities in ieMR performed by observed participants. Qualitative content analysis was used to generate codes from the observation data and comments made by participants

(Braun and Clarke, 2021). This aimed to use the observational content to explain the time spent using ieMR during care provision.

Ethical considerations

This study was granted ethics approval through The Hospital and Health Service, Human Research Ethics Committee (HREC/18/QTHS/96) and local governance at each site obtained. All data were de-identified prior to export and analysis. Individual consent was not sought for the point prevalence phase in-line with Section 2.3.10 of the National Statement on Ethical Conduct in Human Research (National Health and Medical Research Council, 2007). Informed, written consent was sought from participating midwives being observed as part of phase 2 of the study and verbal assent from women. The study was conducted in accordance with the ethical principles from the National Health and Medical Research Council's guidelines. This article has been prepared following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: guidelines for reporting observational studies (von Elm et al., 2007).

Results

The findings are presented sequentially, audit results and then observational data.

Phase 1

A total of 400 client charts were audited across two time points: Time 1 (T1), and Time 2 (T2), following complete ieMR implementation. Client charts were audited across various domains: antenatal care and history taking; pathology and diagnostics; intrapartum practices and documentation; and postnatal cares and assessment. Table 1 presents the key areas of antenatal history taking and documentation according to complete (all data fields complete and in appropriate place) or incomplete (partial data fields completed and in appropriate place), absent (no data fields completed), or inaccurate documentation (some data fields completed but in an inappropriate location) across the two time points.

Pathology (including routine blood tests and investigations) and diagnostics during pregnancy care are collected during the booking-in visit, gestational diabetes screening and 36-week gestation visit. Fig. 1 shows that while documentation of this data item improved, incomplete documentation remained high at time 2. Women's charts were also audited for documentation of ultrasounds including confirmed placental position.

Similar to the results for pathology, key ultrasound scan results (specifically nuchal translucency, 18–20 week morphology and any additional third trimester scans) were recorded in the majority of charts. Several inconsistencies were present, and while

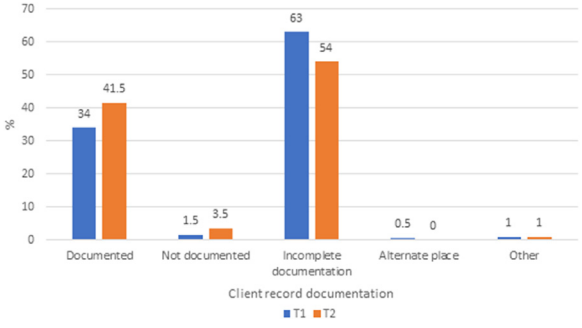

Fig. 1. Antenatal pathology documentation.

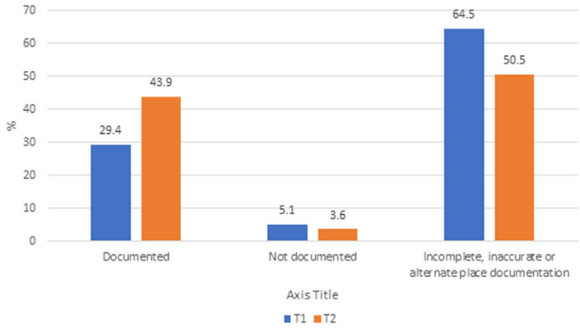

Fig. 2. Antenatal ultrasound documentation.

this improved significantly in the T2 audit ($p = 0.017$), a majority remained incomplete, inaccurate or documented in an alternate place.

Fig. 2

Placental position was documented consistently in most charts at T1 (161, 80.5%), and this improved (although not significantly) at T2 (165, 82.5%, p 0.755). However, documentation in an alternate place was relatively frequent for this variable (T1 30; 15% and T2 28; 14%).

Key areas that clinical stakeholders had identified as having inconsistent documentation with the potential to impact upon patient safety during the intrapartum period were: the regularity of documentation of foetal heart rate (either intermittent or continuous) auscultation (at least every 30 min during the first stage of labour and more frequently in the second stage); and, whether this was documented contemporaneously in the ieMR. Between the T1- and T2-audit periods the rate of contemporaneous documentation of the foetal heart rate (FHR) increased with the majority of FHR documentation occurring ad-hoc (Table 2).

The documentation of immediate newborn assessment was also audited with rates remaining static across time points (complete documentation: T1: 97, 48.5% to T2: 97, 48.5% and absent/incomplete documentation: T1: 103; 51.5% to T2: 103, 51.5%, p 0.61). Similarly, incomplete postnatal assessment documentation was consistently incomplete between T1 and T2 (Absent/Incomplete documentation: T1: 171, 85.5% to T2: 165,82.5%, p 0.20).

Phase 2

Twenty-nine episodes of observation, ranging from 30 min to six hours duration, were undertaken at the two sites across antenatal, intrapartum, and postnatal settings (Fig. 3). Participant midwives ranged in experience from immediate postgraduate to 33 years with 10 of 22 midwives observed having more than 10 years of experience using paper records only, prior to moving to ieMR (missing data for remaining seven participants).

The proportion of time midwives were observed to be active on ieMR ranged from 23% to 68% (median 46%; IQR 16). The proportion of time spent documenting on ieMR was slightly higher in antenatal clinic settings at 50% compared to 39% of the time in birth suite. This time was divided between viewing records for information and entering data. In birth suite additional time was spent interacting with other technology in use such as *fetallink* or *IntelliSpace* for continuous foetal monitoring, and intravenous pumps.

Midwives were observed to be unable to login to PowerChart, the main record for each woman, and not aware of how to access the perinatal data completion checker commenting "*I'm not sure what to do*?". There were multiple instances of a second midwife or student midwife present in birth suite, so that one person could be with the woman and the other entering data, (Table 3).

Table 1
Document completeness pregnancy history.

	Documentation completeness								
	Documented				Incomplete / Inaccurate documentation				Difference *(p value)*
	Time 1		Time 2		Time 1		Time 2		
	N	%	N	%	N	%	N	%	
Antenatal period									
Parity	197	98.5	196	98.3	3	1.5	4	1.8	0.5
Infant feeding history	183	91.5	188	94	17	8.5	12	6	0.22
Feeding intentions	180	90	186	93	20	10	14	7	0.18
Hx feeding difficulties*	91	72	79	70	36	28	34	30	0.34
GP details recorded	112	56	101	50.5	88	44	99	49.5	0.32
Allergies documented	197	99	193	96.5	2	1	7	3.5	0.89
Conception	195	97.5	196	98	5	2.5	4	2	0.5
Current medications	139	69.5	142	71	61	30.5	58	29	0.1
Medications documented in MAR$	21	39	25	50	33	61	25	50	0.47
Medical conditions	153	76.5	169	84.5	47	23.5	31	15.5	0.03#
Pregnancy complications	182	91	182	91	18	9	18	9	0.57
Previous anaesthesia/sedation	158	79	178	89	42	21	22	11	0.01#
Hx blood transfusion	188	94.5	190	95	11	5.5	10	5	0.49
Acceptability of blood transfusion	175	87.5	172	86	25	12.5	28	14	0.38
Tobacco screening	192	96	190	95	8	4	10	5	0.41
Partner tobacco screening	131	65.5	123	61.5	69	34.5	77	38.5	0.47
Illicit/recreational drug use	186	93	178	89	14	7	22	11	0.11
Alcohol use	194	97	154	77	6	3	46	23	0.00#
EPNDS screening	176	88	179	89.5	24	12	21	10.5	0.38
DV risk assessment%	132	80	131	87	32	20	19	13	0.05#

* Only for multiparous women.
$ Only recorded for women currently on medication.
% Other category also included when partner was present and screening not attended (T1: 35, 17.6%; T2 50, 25%).
# Statistically significant difference between time points $p < 0.05$.

Table 2
Intrapartum documentation completeness.

	Documentation completeness								
	Documented				Incomplete / Inaccurate documentation				Difference *(p value)*
	Time 1		Time 2		Time 1		Time 2		
	N	%	N	%	N	%	N	%	
Intrapartum period									
FHR documented 30 minutely^	61	36	67	42	107	64	91	58	0.06
Labour onset documented%	169	94	160	94	10	6	11	6	0.46
Third-stage management	190	95	184	92	10	5	16	8	0.26
Uterotonic documented in MAR	148	76	139	70	47	24	59	30	0.23
Perineal repair (inc consent)*	81	60	67	46	57	40	79	54	0.07
Epidural cessation & tip inspection@	30	45	33	51	33	55	32	49	0.92

^ 32 records were NA as woman had an elective caesarean, so no intrapartum FHR required.
% a total of 50 charts included 'no labour'.
* 116 were not applicable (no injury or caesarean birth).
@ 272 (67%) were not applicable as no epidural anaesthesia.

In antenatal clinic, a second midwife was only present when a midwife was learning the ieMR or being orientated to the setting. Being shown how to do different things took time, such as learning how to create a favourite for a regular order in the Medication Administration Record or to access maternity trackers to check booking in details. Accidently touching the computer and losing data was also observed with data needing to be re-entered. When checking the record before moving a woman to the postnatal ward, missing information was identified resulting in time taken contacting prior staff from the previous shift for clarification of medications given or information required for completion. The use of workarounds was observed (Table 4).

Midwives documented observations at point of care contemporaneously into interactive view at the computer by the bedside. However, often they were interrupted to provide for a woman's needs while documenting. Several instances of midwives communicating to women that they needed to document into the computer during care provision were observed such as "*Sorry about*

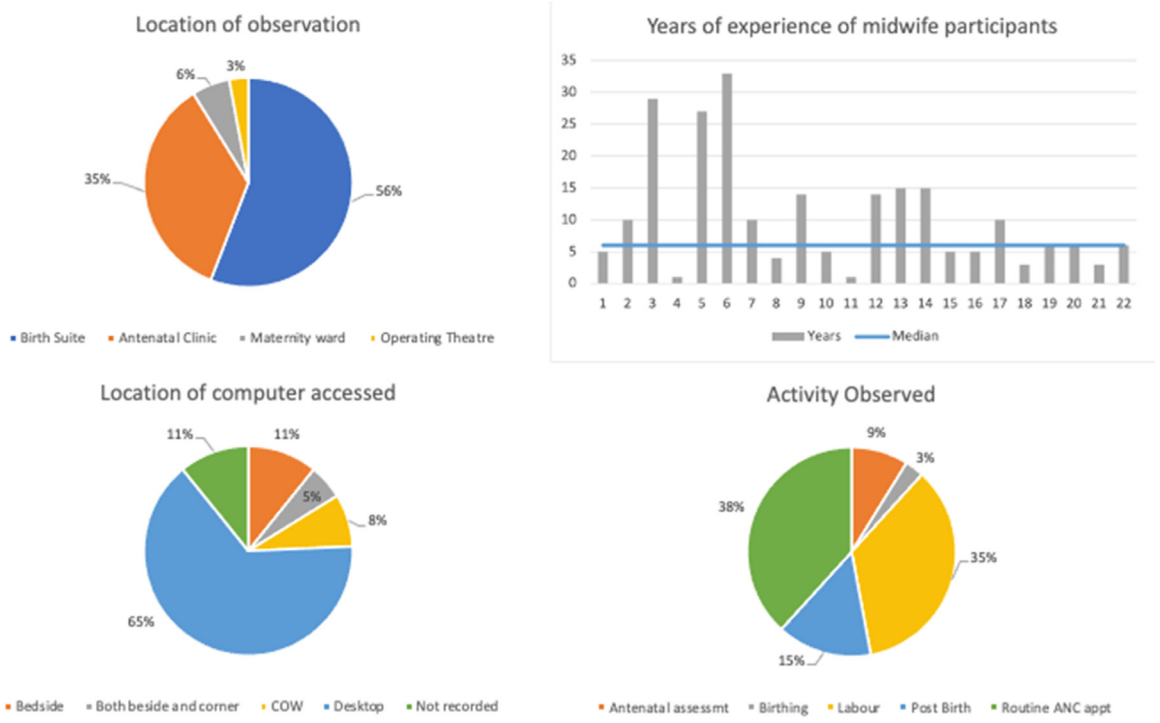

Fig. 3. Details of observations across all clinical areas of both sites.
NB: IQR = 9; Missing data for 7 midwives excluded.

Table 3
Descriptions of documentation challenges observed.

Setting	Observed action	Consequence
BirthSuite	Needed help ordering bloods and how to put ordering physician info; how to document bolus fluids; reminded how to document PIVC in lines and devices (forgotten)	Second Midwife required to assist; on the job training taking place.
BirthSuite	Exited ieMR incorrectly - through change NOT blue door	Leaves record open; potential for multiple instances of open records and real time data inaccurate.
BirthSuite	BGL Observations for neonate documented on feeding chart (paper) as unaware where to put in ieMR	Documentation missing in ieMR for other clinicians
BirthSuite	Midwife needed help ordering bloods and how to put ordering physician info; how to document bolus fluids; reminded how to document PIVC in lines and devices (forgotten)	Second Midwife required to assist; on the job training taking place.
BirthSuite	Midwife unaware how to get to Maternity Tracking to check booking in details	Second Midwife required to assist; on the job training taking place.
BirthSuite	Not aware of how to access PDC completion checker to see what hasn't been completed in ieMR	Second Midwife required to assist; on the job training taking place.

Table 4
Description of workarounds observed.

Setting	Observed action	Consequence
Antenatal clinic	Prefer to use visit card at end as there is a bigger box on the visit card than on the encounter notes	Multiple locations of entered data
Antenatal clinic	One midwife showing another how to add pregnancy complications in interactive view, refresh so visible on front page	Improved access to information
BirthSuite	Midwife on night duty had written notes on paper to give to Midwife coming on in morning. Midwife read and used this information rather than accessing ieMR until much later.	Potential for lack of current information informing care

this. Excuse us while we document all this information". Similarly, a midwife commented *"The biggest thing with this (ieMR) is that you have to look away from the patient. I like to have the ieMR screen (2 screens in room) closest to the patient so that I'm not turning away from them so much"*

In birth suite, asynchronous documentation was the norm with evidence of writing notes on paper in the meantime to be transcribed later. Comments from midwives included: *"I've done most (of the necessary) documentation in ieMR but I feel like I haven't spent any time with this couple having their beautiful baby!"*

"I don't think anyone realises how hard ieMR is if you are not familiar with it!"

"Then you get into trouble for not documenting things or not correctly and they wonder why when you don't get enough help."

Midwives expressed concern that they were not competent with the technology in comments while being observed such as "*I don't feel very computer literate. I didn't learn computers at school. My kids sort all my technology at home"*

"ieMR for me has been really difficult. What I have learnt is through trial and error and I make lots of errors!"

"I like my piece of paper to refer to, so I don't have to scroll through ieMR all the time".

Discussion

This study examined midwives' documentation from two maternity sites through audit and observation following implementation of an integrated electronic medical record (ieMR). Health record auditing overall found patient data to be complete and entered in the correct place for most fields examined with significant improvements in the accuracy and completeness of data seen for medical conditions, previous anaesthesia or sedation, and domestic violence risk assessments between time points. However, areas where large proportions of data were missing or entered in alternate places at both time points were identified, such as ultrasound results. Similarly, observation identified that managing new documentation processes to record data in the ieMR impacted on midwives' interactions with women.

A woman's history of feeding difficulties was poorly recorded at both time points (28% and 30% respectively), as was GP details (61% and 50%) and partners tobacco use (34.5% and 38.5%). Recording of alcohol use significantly worsened over time in our study. These data items may be considered less important than clinical findings yet have an impact on the health of the newborn. Past breastfeeding difficulties are found to be detrimental to subsequent breastfeeding intent and duration (Huang et al., 2019) so without this data recorded for all women, infant outcomes may be impacted. Similarly, education on smoke free environments, as recommended by the World Health Organisation (2013) for optimal infant health and reducing risk of sudden unexpected infant death, may be overlooked without complete and accurate data recorded on the tobacco use of the woman's partner.

Improved completeness of data over time for variables such as medical conditions, and previous anaesthesia/sedation suggests that continued use of ieMR by midwives resulted in improved usage. This improvement over time aligns with Diffusion of Innovations theory. Rogers (Rogers, 1995) determined that complex innovations, such as seen in ieMR, require users to see relative advantage and compatibility with their current practice for successful adoption. Similarly, the Technology Acceptance Model (TAM) developed by Davies (Davis, 1989) equates adoption with ease of use and perceived usefulness of technology, that is the perception of the compatibility between work value and demands and technological abilities.

Existing low rates of information in the correct location in some areas of the ieMR identified in this study suggest a disconnect between midwifery practice and the utility and usability of the software in use, that it is not fit for purpose. This was confirmed within the observational part of our study, where midwives expressed confusion and frustration at the time taken to find important patient information. Arguably this has an impact on midwives' ability to provide woman-centred care (Craswell et al., 2021). Healthcare providers are the buyers and users of EMR systems and therefore are the focus of EMR system designers (Saleem et al., 2014). Integrating EMR systems into clinical environments while maintaining woman-centred care is an ongoing challenge with studies such as this assisting to understand how digitalisation of records impacts both midwifery practice and data quality. There is very little evidence related to midwives use of EMRs. Studies of nurses observed perceived negative impacts on patient relationships, communication, and caring behaviours (Gesner et al., 2019; Misto et al., 2019; Schenk et al., 2018). Several studies observed that the required focus by nurses on EMR and computers negatively impacted on patient centred care (Kossman and Scheidenhelm, 2008; Misto et al., 2019). However, Wynter and colleagues (Wynter et al., 2021) report that participants (both nurses and midwives) found the EMR acted as both a catalyst and a hinderance for their communication with patients. These findings are of particular importance when examining EMR systems in maternity care due to the unique holistic needs of woman and baby across the continuum of antenatal, intrapartum, and postnatal care (Helou et al., 2019).

In addition, the observation of 'workarounds', such as keeping notes on paper for data entry at a later time, indicate the complexity of EMR systems (Cresswell et al., 2017), particularly in emergencies when asynchronous recording of data remains common (Lee and Lee, 2021). This practice introduces risk in accuracy and completeness, clinical information that is not up-to-date and documentation burden when copying notes from paper later (Cresswell et al., 2017; Stevenson et al., 2018). In our study, observation in birth suite of the midwife being with the woman was balanced with the need for contemporaneous documentation. Such commitment to interaction with patients is reported by other health professions (Blijleven et al., 2019). However, Scantlebury et al. (2017) observed that midwives who reported a negative perception of electronic records found the detrimental impact on their interactions may be constrained to the early implementation phase.

Strengths and limitations

While research on digital health records is not uncommon, midwifery is an area with different challenges and scant evidence to understand the impact of digitalisation. This study has the advantage of being conducted across more than one site implementing the same system evaluating impact through both audit and observation. However, this does not equate to generalisability to all maternity sites or geographical regions using ieMR. The research is limited by the potential for bias from observers who bring their own clinical experience and personal values to the role. Similarly, while the authors took steps to ensure reliability in the audit process, it remains context specific and may not be broadly generalisable to other contexts.

Conclusion

Contemporary midwifery practice requires quality documentation to support the provision of woman-centred care. Lack of access to complete data, recorded in the correct location, removes midwives from directly caring for the woman – a critical aspect of midwifery practice and foundational to woman-centred care. Decision makers in Health Services choosing systems for electronic record implementation have a responsibility to ensure that any new technology impacting on clinical services is fit for purpose, and as such is usable and intuitive to the setting in which it is applied. We recommend that future improvements to the digitalisation of health records is informed in strong consultation with midwives to ensure it optimises, rather than detracts from woman-centred care. Findings from this research and future studies need to be translated into midwifery settings to support midwives to overcome the challenges digital records create.

Ethical approval

Ethics approval was granted by Townsville Hospital and Health Service Human Research Ethics Committee (HREC/18/QTHS/96) with a waiver of consent granted in line with Section 2.3.10 of the National Statement on Ethical Conduct in Human Research. Local

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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.

CRediT authorship contribution statement

Lauren Kearney: Methodology, Formal analysis, Writing – original draft. **Alison Craswell:** Data curation, Formal analysis, Writing – original draft. **Roni Cole:** Data curation, Writing – review & editing. **Mariann Hadland:** Data curation, Writing – review & editing. **Wendy Smyth:** Conceptualization, Funding acquisition, Methodology, Project administration, Writing – review & editing. **Cate Nagle:** Conceptualization, Funding acquisition, Methodology, Writing – review & editing.

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