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ORIGINAL RESEARCH

Dietetics in the Digital Age: The Impact of an Electronic Medical Record on a Tertiary Hospital Dietetic Department

Running Title: Dietetics in the Digital Age

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Abstract

Aim: This study aimed to assess the impact of a hospital wide electronic medical record on the way dietitians collect routine data for their assessments and its impact on their clinical documentation and service provision.

Methods: Data were collected retrospectively from the following sources: interdepartmental chart audit, the electronic medical record itself (nutrition diagnosis), National Health Roundtable database (admissions requiring nutrition events) and the hospital wide Pressure Injury Prevention Audits (height, weight and malnutrition screening).

Results: There were improvements in medical record accessibility (76.4% pre vs 100% post, $p<0.001$), awareness of medical alerts (82.5% unaware pre vs 34.5% unaware post) and legibility of documentation (53.8% pre vs 99.2% post, $p<0.001$). Improvements accessing medical charts in under one minute also occurred (65.8% pre vs 99.2% post, $p<0.001$). The percentage of nutrition diagnoses resolved during admission increased from 20.0% in February 2016 to 34.0% in August 2017. A 72.0% increase in admissions requiring nutrition interventions was found with 4075 admissions pre and 7035 post electronic medical record implementation.

Time spent per nutrition event reduced by 22.0% (118min pre and 92min post). Hospital audit data revealed mean height and weight collected increased from 79.3±3.8% (n=8 audits totalling 3041/3834 patients) to 86.0±2.6% (n=5 audits totalling, 2544/2958 patients) post electronic medical record with malnutrition screening completion increasing from 58.9% to 74.0%.

Conclusions: The findings of this pilot study indicate electronic medical record implementation has the potential to benefit the dietetic profession due to the potential to enhance the capacity and efficiency of dietetic departments.

Key words: Electronic Medical Record, e-health, dietitians, nutrition informatics.

Introduction

The use of health information technology within the hospital system is changing the way health professionals across the globe provide health care by increasing access to services, improving patient safety, increasing efficiency and reducing costs.[1-3] Specifically, the introduction of electronic medical records (EMRs) has paved the way for this revolution to occur. However, a significant proportion of the current literature relating to electronic medical records has been conducted in physician and nursing populations.[3-5] Evidence relating to the impact of electronic records on nutrition professionals practice and clinical workflow is still very limited,

despite the profession acknowledging the value of digital approaches to support practice over a decade ago.[1,6-8]

Evidence suggests the introduction of EMRs has reduced medication errors, adverse drug events, length of stay, laboratory testing, radiological testing and medication administration times.[2,3] The quality of care and the ability to monitor patients' vital signs have reportedly improved due to the introduction of these systems.[2,3] Other stated improvements include decreases in documentation time for nursing staff.[9] Existing literature suggests there may be differences in the way health professionals are affected by EMRs depending on their role in the system with some studies having also reported possible negative consequences of EMR introduction. An example is an increased burden on physicians due to increased documentation time.[9]

The potential advantages for nutrition professionals using EMRs has been outlined extensively in the qualitative literature (invited reviews, invited commentary etc.) although limited quantitative evidence exists relating specifically to the nutrition and dietetics profession.[1,10-21] The implications discussed in this dietetic literature include; data integration, tracking and reporting, cost savings, improved clinical decision making and improved patient care.[11-13,16] Improved documentation and ordering of clinical nutrition interventions resulting in reduced risk of drug nutrient interactions, transcription errors, incompatibilities in parenteral nutrition

formulas and provision of clinical decision support as well as the ability to transfer nutrition-related documentation across institutions has also been described in surveys of clinicians.[7,10]

A small number of studies have quantitatively assessed the impact of EMRs on dietitians. An electronic record implementation reduced the time spent undertaking nutrition assessments by thirteen minutes (57min/pt with electronic record vs 70min/pt with paper records).[22] This reduction translated to an estimated cost saving of USD $6,500 to $10,000 annually in this particular outpatient setting (using hourly rate of USD $25/hour).[22] Other workload efficiencies have also been shown, including reduced time to complete nutrition calculations,[23] increased services by nutrition support staff[24] and an increase in the number of resolved nutrition diagnosis.[22] This research is often limited in scope and often focuses on systems used within an individual ward or systems only used by dietitians, rather than a hospital wide EMR implementation.[22,24]

The aims of this study were to understand the impact of an EMR on individual dietitians; examine the effect of an EMR on the data routinely used in nutrition assessments and investigate the changes to clinical practice and dietetic service provision.

Methods

This retrospective study was conducted at a 900 bed tertiary teaching hospital located in Brisbane, Australia. Four separate data sets were collected for analysis to provide an overall picture of the changes that have occurred since EMR implementation.

A retrospective analysis of departmental chart audit data, collected pre and post EMR implementation, was undertaken. This audit was completed at a dietetic departmental level, encompassing both inpatient and outpatient services. Data was collected for three consecutive days, two weeks prior and 12 months' post implementation. The audit items included patient safety considerations (difficulty and timeliness of chart access, reason for delay in chart access, legibility of documentation, clarity of referrals), identification of patient alerts (allergies, malnutrition, pressure injury, interpreter, vision or hearing impairments) and the ability and time required to locate documented weights and weight history. This was a department level quality audit tool and as such validity and reliability was not assessed.

A retrospective analysis of the Pressure Injury Prevalence Audit was undertaken. This audit is completed quarterly with the results reported to the hospitals' Nutrition Care Committee. The main aim of the audit is to determine the prevalence of hospital acquired pressure injuries; however nutrition related data is also collected. The analysis compared the result of this audit pre EMR and then 12

months' post EMR implementation, to assess any significant changes with implementation of an electronic record. The specific items included in this analysis are weight and height documentation on admission and malnutrition screening on admission.

A quantitative analysis of the nutrition diagnosis data that is entered into the EMR by clinical dietitians for each patient occasion of service were assessed. Reports were generated within the EMR and exported into an Excel (Microsoft, Redmond, WA) spreadsheet. All diagnosis recorded within the EMR during the first week of each quarter since implementation were analysed. The key metrics analysed in this study were the proportion of patients seen by a dietitian who have a nutrition diagnoses entered within the EMR, percentage of diagnoses resolved, and time taken for these diagnoses to be resolved.

Information on dietitian service provision was collected from the Health Round Table reports.[25] This was used to analyse the service provision of the dietetics department pre and post-EMR implementation. Three years' worth of data was analysed, pre-EMR (2013-2014), transition year (2015-2016) and post-EMR (2016-2017). Service provision within this data is reported as admissions requiring nutrition events. This data does not report individual events specifically and therefore does not report on all occasions of service for the dietetic department as

admissions may require more than one dietetic consultation. Outpatient data is also not captured within the Health Roundtable Report.

Summary statistics were expressed with descriptive representations such as counts and percentages. Data was presented over time where applicable to demonstrate changes between the pre and post-EMR implementation measures. Statistical analysis was carried out using SPSS (IBM SPSS Statistics for Windows Version 25. Armonk, NY: IBM Corp.) for the audit data and a Chi-Square Test was used to determine statistical significance. This study was approved by the Metro South Hospital and Human Research Ethics Committee (HREC/17/QPAH/546).

Results

The dietetic chart audit was completed pre and post-EMR implementation by 29 and 21 dietitians respectively. There were large improvements in medical record accessibility, referral clarity, weights being located in records, awareness of alerts and legibility of documentation, time to access medical records were and time to locate weight documentation (Table 1).

Pre-EMR 75.7% (n=137/181) of clinicians were able to access patient medical records compared with 100% (n=119/119) post-EMR ($p < 0.001$). Access to charts within one minute improved from 68.5% (n=106/183) to 99.2% (n=119/120) post-EMR (Table 1, $p < 0.001$). Medical record legibility improved from

53.8% (n=74/141) reporting very good pre-EMR to 99.2% (n=117/118) post-EMR (p <0.001). Clinician lack of awareness of medical alerts (e.g. food allergies, need for interpreter) dropped from 91.4% (n=83/103) pre EMR to 34.5% (n=38/110) post-EMR (p <0.001).

Nutrition diagnosis data was unable to be tracked pre-EMR. Post-EMR the total number of nutrition diagnoses increased from 155 to 227 post-EMR implementation between February 2016 and August 2017. The percentage of resolved diagnoses was also reported. Initially in the first quarter of implementation 20.0% (n=31) of diagnoses were resolved. There was a trend for increasing resolutions of nutritional diagnoses over the 18 months' post-EMR implementation with resolution rates peaking at 41.2% (n=80) in May 2017. The mean number of days it took to resolve nutrition diagnoses reduced from 51.5 days (n=17) in February 2016 and reached its lowest in November 2016 with 26.2 days (n= 71). In the final quarters of February, May and August in 2017, the mean number of days to resolution stabilised at 32.1 days (n=50), 34.0 days (n=73) and 31.0 days (n=64) respectively.

Results from the quarterly pressure injury prevalence audit report demonstrated improvements in data collected during admission used in dietetic practice. The mean percentage of heights and weights collected during 8 audits (n=3834 patients) pre-EMR was 79.3±3.8% and rose to 86.0±2.6% during 5 audits

(n=2958 patients) post-EMR implementation. A similar trend was also seen for the number of malnutrition screening tools (MST) completed on admission. The mean pre-EMR screening was 57.5±6.4% (n=8 audits) and increased to 74.0±8.1% (n=5 audits) post-EMR. The percentage of patients who were identified as at risk of malnutrition (MST ≥2) increased from 25.3% pre-EMR to 29.1% post-EMR implementation (Figure 1).

There were 4075 people admitted who received a nutrition intervention pre-EMR (2014-2015), 5687 during the transition year (2015-2016) and 7035 post-EMR implementation (2016-2017), a 72.6% increase. The mean time for each nutrition event reduced 22.0% from 118 minutes pre-EMR to 106 during the transition year and to 92 minutes post-EMR.

Discussion

There has been limited quantitative research conducted to understand the effect of EMRs on dietetic practice and workflow. Although work overseas exists[24] this is the first study to assess changes within a tertiary hospital in Australia following hospital wide implementation of an EMR. Previous work in Australia and internationally has investigated the effect of specifically digitising nutrition records alone, both across a hospital[24] and on specific wards.[22] The study results show there are many areas where electronic records have positively influenced day to day practice including

an increased ability to find weights, access charts, notification of alerts, improved height/weight recordings on admission and improved MST screening on admission. Results from the current study are consistent with previous literature finding nutrition specific electronic record implementation increased recording of height and weight during admission from 30% at baseline to 90% within 3 years at a 650 bed hospital.[24]

The time to access charts and find recorded weights was reduced with the introduction of an EMR. These results are consistent with literature that has shown operational efficiency with EMR implementation across professions.[3,23,26] Research assessing the time taken to complete clinical nutrition documentation showed a reduction of 13 minutes per consultation[22] and a reduction in time taken to perform nutrition calculations from 9.7 minutes to 3.2 minutes post EMR implementation.[23] Physical therapists have also reported reductions in documentation time by as much as 30%.[27,28] For nursing staff documentation time reduced with EMR implementation by as much as 24.5% depending on the computer set up (i.e. bed side access or central station desktop).[9] This is consistent with the results from this study as the dietetic chart audit indicated a minimum of nine hours of dietetic time could be saved weekly from being able to access patients' medical records immediately. This has enabled the use of previously non-productive staff time to enhance patient care through other means.

A key finding from the current study is the large increase in the number of nutrition events year on year since the implementation of an EMR. Between the financial years of 2014-2015 and 2016-2017 there was a 72.6% increase in the number of admissions receiving a nutrition intervention. This was despite little change to the mean number of nutrition events reported per admission and no increases to the number of clinical staff. This increase is only for inpatient admissions and may be an underestimation of the total increased demand as outpatient appointments have not been assessed in this study. Similar increases have been published with one international hospital reporting referrals handled by the nutrition support team and clinical dietitians increased 54.11% from 7,374 in the year 2000 to 11,369 in 2003.[24] The authors speculate the ability to handle such large increases in service provision is likely the result of a combination of factors; however improved efficiency from the introduction of an EMR, including specific design features, is likely a major influence.

With the introduction of a specifically designed EMR, nutrition diagnosis data is now more accessible and can be incorporated into routine departmental audits. The percentage of nutrition diagnoses that were resolved during admission increased from 20% in February 2016 to 34% in August 2017. The literature regarding nutrition diagnosis resolution in hospital settings is mixed. Literature has shown both improved resolutions rates in a haemodialysis cohort[22] and no

difference when implemented in a tertiary teaching hospital.[29] The present results are consistent with an increase in resolution rates. It is speculated these results are likely due to the improvement in the delivery of nutrition care and the ability of an EMR to track patients, which facilitates proactive care and increased accuracy of triaging clinician time, as other authors have also suggested.[22]

The results of the nutrition diagnosis audit are difficult to interpret as the number of diagnoses actually captured within the EMR was variable. The trend was for an increased number of diagnoses recorded within the EMR since the implementation. The authors speculate this is a result of clinicians becoming more familiar with the EMR system and the change champions within the department encouraging staff to enter the diagnosis into the section required to generate reports. The system requires nutrition diagnoses and progress to resolution to be entered in a separate section to the remainder of the dietetic documentation within the EMR. This impacted upon nutrition diagnoses recording within the EMR. Improvement in nutrition diagnoses documentation and resolution is anticipated if integrated as data fields within the clinical notes written by dietitians in the EMR. As others have suggested, increased use of the EMR and subsequent increase in diagnosis data will improve the ability to undertake future outcomes-based research.[30]

One study strength is the completion of this research in the real-world setting. The data collected is routinely collected in clinical practice and allows for analysis of trends pre- and post-EMR implementation. The complex work environment of a large tertiary hospital also provides strength to this study. To the author's knowledge there has been no literature published previously which has looked at the effect of a hospital wide EMR implementation on a dietetics department in Australia or internationally. Data such as the Health Round Table data is standardised across health services and collected on a national and international scale.

There are several limitations that need to be considered. This was not a randomised controlled trial and the retrospective nature of this study did not allow for the assessment of causality. However, the intention of the study was to retrospectively analyse changes post-EMR implantation. Future studies planning to assess changes post-EMR implementation could be more rigorously designed to allow maximum data collection and compliance from clinicians. This would enable the researchers more control over the prospective data collection, such as the dietetic chart audit used in this study. Other limitations include the different study population for the dietetic chart audit. Staff movement in a tertiary hospital dietetic department is frequent and it is likely not all those who completed the survey pre-EMR implementation would have completed it post, with others not having

completed the pre-survey and only completing it post-EMR. There were also some incomplete data collected from the surveys as some clinicians did not answer every question. This is likely to have resulted in an underestimation of the impact of the EMR, and as such the results presented may be conservative.

The findings from his study complement recently published work in the nutrition informatics space which established the Framework for eHealth Readiness of Dietitians (FeRD).[31] This conceptual model includes dimensions such as aptitude, advocacy, access, standards and attitude which help guide the profession in its successful transition to eHealth[31] and has been developed to provide dietitians with a framework to assess and drive strategies to prepare the profession for the digitisation of the healthcare system.[31] There are a number of insights provided within this paper including improved patient safety, improved accessibility saving clinician time and the ability to impact on the nutrition care of more individuals. This understanding could be used to influence professional attitudes, standards and advocacy and guide development of a targeted strategy to better prepare dietitians for an EMR implementation at other hospitals.

The future of dietetics within this digital space appears bright. The authors anticipate the use of specifically designed EMRs will allow dietitians the ability to run reports in real time and integrate this information into nutrition dashboards. This ability to track information contained within the EMR will also allow clinicians

to assess if changes in clinical practice have impacted outcomes in a more systematic manner than is currently available. These changes will continue to improve patient care and the quality of service that is provided to patients. Future research investigating dietetics and EMR's should focus on the patient outcomes and how these systems can be optimised to continue to improve clinical efficiency in dietetic practice.

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Conflict of interest

The author reports no conflict of interests.

Authorship

J.M. and A.V. conceived and planned the study with assistance from S.E. J.M. and A.V. complied the results and A.V. carried out statistical analysis. J.M., A.V. and S.E. contributed to the interpretation of the results. J.M. took the lead in writing the manuscript. All authors provided critical feedback and helped shape the research, analysis and manuscript.

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Figure 1: Percentage of Patients at risk of Malnutrition (MST 2 or more) Pre and Post EMR

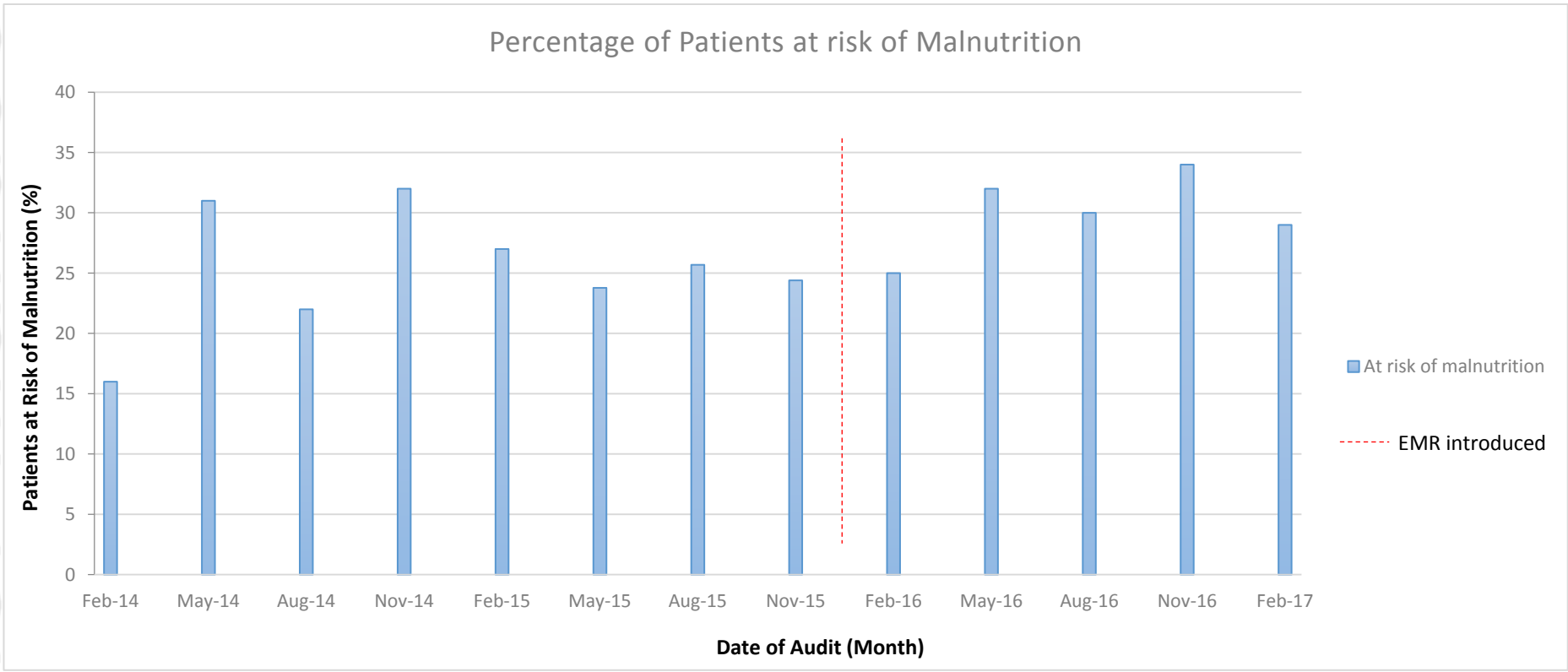

Table 1: Dietitian Chart Audit Pre and Post EMR

		Pre EMR (Total N=183)		Post EMR (Total N=129)		Statistical Significance
	Response	**N**	**N (%)**	**N**	**N (%)**	**P-value**
Accessibility of Chart	Yes	181	136 (76.4)	119	119 (100)	P <0.001
	No		36 (20.2)		0	
	Partial		6 (3.4)		0	
Time until Access	< 1min	161	106 (65.8)	120	119 (99.2)	P <0.001
	1-5 min		35 (21.7)		1 (0.8)	
	>5 min		20 (12.4)		0	
Referral Clarity	Purpose	183	61 (33.3)	129	97 (75.2)	P <0.001
Referral Clarity	Referrer	183	55 (30.1)	129	58 (45.0)	P <0.001
Referral Clarity	Pertinent History	183	42 (23.0)	129	64 (49.6)	P <0.001
Time looking for Weight (minutes)	< 1	114	97 (85.1)	117	112 (95.7)	P <0.01
	1-5		11 (9.6)		5 (4.3)	
	>5		6 (5.3)		0	
Weight Found	Yes	106	88 (83.0)	108	100 (92.6)	P <0.01
	No		13 (12.3)		2 (1.9)	
	Partially		5 (4.7)		6 (5.6)	
Other Relevant Data	Yes	119	114 (95.8)	125	125 (100)	P <0.05
	No		5 (4.2)		0	
	Partially		0		0	
Consult Alerts	Unaware	103	85 (82.5)	110	38 (34.5)	P <0.001
	Aware prior		13 (12.6)		72 (65.5)	
	Aware during or after consult		5 (4.9)		0	
Legibility	Very Good	141	74 (52.5)	118	117 (99.2)	P <0.001
	Good		38 (27.0)		1 (0.8)	
	Neutral		8 (5.7)		0	
	Poor		14 (9.9)		0	
	Very Poor		7 (5.0)		0	