The completeness of electronic medical record data for patients with type 2 diabetes in primary care and its implications for computer modelling of predicted clinical outcomes.

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ABSTRACT

Background: Computer models predicting outcomes among patients with Type 2 Diabetes (T2D) can be used as disease management program evaluation tools. The clinical data required as inputs for these models can include annually updated measurements such as blood pressure and glycated haemoglobin (HbA1c). These data can be extracted from primary care physician office systems but there are concerns about their completeness.

Objectives/methods: This study addressed the completeness of routinely collected data extracted from 12 primary care practices in Australia. Data on annual availability of blood pressure, weight, total cholesterol, HDL-cholesterol and HbA1c values for regular patients were extracted in 2103 and analysed for temporal trends over the period 2000 to 2012. An ordinal logistic regression model was used to evaluate associations between patient characteristics and completeness of their records. Primary care practitioners were surveyed to identify barriers to recording data and strategies to improve its completeness.

Results: Over the study period completeness of data improved substantially from less than 20% for some parameters up to a level of approximately 80% complete, except for the recording of weight. T2D patients with Ischaemic Heart Disease were more likely to have their blood pressure recorded (OR 1.6, p=0.02). Practitioners' responses suggest they were not experiencing any major barriers to using their electronic medical record system but did agree with some suggested strategies to improve record completeness.

Conclusion: The completeness of routinely collected data suitable for input into computerised predictive models is improving although other dimensions of data quality need to be addressed.

INTRODUCTION

The prevalence of and health burden associated with Type 2 Diabetes Mellitus (T2D) is increasing and its management poses great challenges for primary care physicians [**1**]. In Australia general practitioners provide the vast majority of primary care services for patients with T2D within a fee for service remuneration system. Over recent decades many countries including Australia have attempted to address this issue by introducing primary care programs [**2**] aimed at improving the quality and coordination of routine care for people with T2D through the implementation of well-established evidence based primary care management guidelines [**3,4**]. However, a significant gap exists between recommended guidelines and primary care practice in Australia [**5,6**].

Relatively recently there has been interest in computerised predictive modelling of clinical outcomes for patients with T2D [**7,8**] with some quite sophisticated techniques using iterative approaches to quantify changes in risk factors and/or disease states. One such model is the UKPDS Outcomes Model which has recently released an updated version [**9**]. This model has the ability to predict life expectancies using individual level data and its use has been suggested as a novel approach to evaluating primary care initiatives aimed at improving the management of T2D [**10**].

The data these models require are recommended to be routinely collected within general practice [**11**] and many of the current general practice medical record software packages used in Australia have structures designed to facilitate their collection. The data required includes patient history, clinical observations and laboratory results. Data extraction tools that access electronic medical record systems are increasingly being used for quality assurance activities within Australian primary care with recent attention being given to the validity of the information obtained [**12, 13**]. One study has concluded that current tools may be unreliable [**12**] and recent experience has also raised concerns about the completeness of these data outside of formal research trials [**10,14,15**].

One of the major challenges to using routinely collected primary care data suitable for input into computer models to predict outcomes such as life expectancies is the extent to which general practitioners enter data through free text into a general notes field rather than through structured coded fields. Previous research has identified that barriers to physicians entering clinical data as coded entries rather than free text include time constraints during consultations [**16**], issues with software interfaces and codes [**16**,**17**], and the under appreciation of the usefulness of coded data as a quality indicator [**18**]. Although attempts have been made to extract clinical observation data from free text fields [**19,20**] such approaches are likely to have inherent limitations related to variations in users' text recording practices. Several Ontological techniques have also shown promise and been demonstrated to improve case finding for the creation of T2D disease registers [**16,21,22**]. A recent literature review relevant to routinely collected electronic clinical data and chronic disease management identified completeness, accuracy, correctness and timeliness as major dimensions that need to be considered when assessing data quality for both research and patient care purposes [**23**].

This study examines electronic data extracted from Australian general practice electronic medical records systems being used routinely outside of a formal research trial environment. The objectives of the study were first; to describe the completeness of clinical data for the management of T2D in primary care extracted from an electronic physician office system; second to determine whether patient characteristics were associated with completeness of data and; third to report general practitioners' self- reported barriers to recording data and strategies that might overcome these barriers.

METHODS

Physician Office System:

Data was analysed from twelve general practices that had previously participated in a study looking at evaluating the impact of a primary care program on the management of T2D in the Australian general practice setting [**10**]. All practices used the medical software Best Practice ™ as their electronic medical record system. This software has been designed specifically for the needs of Australian general practitioners and has the ability to record current and past visit notes, past medical conditions, clinical observations and laboratory results, both through the use of free text and/or structured drop down menus. Best Practice ™ software was introduced into Australian general practice in 2004 and it has the capacity to receive comprehensive data migration from other computer software packages that were in use prior to this date.

Within Best Practice ™ general practitioners can enter coded data in parts of a patient's medical record, for example, "reason for visit" or "past medical condition" by selecting an option from a series of drop down menus. The system then uses its own internal coding dictionary to record this data in structured tables. These fields also have a capacity for the practitioner to enter free text if there is not a suitable option available in the drop down menu. Best Practice ™ has several designated areas within a patient's medical record for entering clinical measurement data e.g. weight and blood pressure, and although practitioners can also enter these data within a general free text notes field (the "Today's notes" field) the data will not be readily accessible unless it is entered into a designated data area.

The software also has the ability to receive laboratory data provided it is presented in a standard format (Health Level Seven (HL7)) and then assigned a unique internal code (Logical Observation Identifiers Names and Codes (LOINC)) to facilitate storage, analysis and presentation. All laboratory data are required to be reviewed by the general practitioner prior to incorporation into a patient's

medical record and the software has the ability to display summaries of past readings to monitor patient care.

Identification of T2D patients and their clinical data:

Data from twelve individual practice systems were extracted using simple Structured Query Language (SQL) programs written by the researchers. Clinical data were only extracted from the designated internal tables within the software and although there was limited free text searching of the "past medical history" field no free text searching of the "Today's notes" field was performed.

Patients with T2D were identified through electronic searching of the "past medical condition" and "reason for visit" fields (recorded in the Past History internal table) for T2D related codes or free text terms identifying the condition T2D [**15**] and supplemented by a search for glycated haemoglobin (HbA1c) levels above 6.5% (48 mmol/mol) [**24**]. Predictive computer models can set patient eligibility criteria based upon age at T2D diagnosis [**9**] and consequently only patients who had been diagnosed with T2D between the ages of 45 and 64 years who were regular patients were included in the study analysis. Patients were only included in the study for the period after they were diagnosed with T2D. Being a regular patient was defined as having presented to an individual practice on at least two occasions per year with this status allowed to change from year to year dependent upon the number of visits made to a practice during the relevant calendar year. The clinical data assessed included blood pressure, weight, HbA1c, total cholesterol and HDL-cholesterol. These five data parameters were chosen as they are often required to be included as inputs into models that predict clinically relevant outcomes, for example, life expectancy) [**9**]. Their availability at least on an annual basis is required by some predictive models and the presence of an annual reading was the major study outcome factor.

Study period and patient characteristics:

Data for the period 2000 to 2012 inclusive were available and examined to look for a temporal trend. Data were also analysed to look for an association between patients' characteristics (age, gender,

length of time since diagnosis of T2D, presence of comorbidities) and availability of annual data for the five clinical data parameters. Comorbidity was considered as a dichotomous variable with a past history of ischaemic heart disease, myocardial infarction, stroke, atrial fibrillation, peripheral vascular disease, chronic renal failure and/or blindness considered significant.

General Practitioner Survey:

A questionnaire asking medical practitioners about their usual practice concerning measuring clinical and laboratory data for their T2D patients was offered to all 12 practices in March 2015 with a maximum of 3 responses per practice permitted (appendix - instrument). They were also asked about when they manually entered data into a patient's record whether they did this as free text or used a coded drop down menu. The questionnaire also asked for their opinion about a series of potential barriers to recording data and strategies that could be used to overcome these using a 5 point Likert agreement scale. The survey was developed based upon existing literature (16,17,18) and consensus between two of the study's authors. Practitioners had the option to compete the survey on-line or in a written form.

Statistical Analysis:

Temporal trend in data completeness

As overall data completeness was poor in the period prior to 2009 formal analysis of a change in data completeness was only considered for the period 2009 to 2012. Temporal trends were described by reporting the proportions of patients with T2D having at least one data reading in a given calendar year for each of the five clinical data parameters. The denominator consisted of the number of regular patients who had attended a practice in the relevant calendar year. A formal test for trend was performed using a fixed effects logistical regression analysis for panel data for the cohort of T2D regular patients who were considered as regular patients for the year 2009 (**25**). The outcome variable was the presence of a plausible reading determined by face validity and the years 2010, 2011 and 2012 were treated as dummy variables.

Patient characteristics and data completeness

Multivariate ordinal logistic regression employing back-selection estimation was used to test for associations between recording of annual values for the five clinical parameters over the period 2009 to 2012 and patient characteristics noted in 2009. The outcome was the number of annual values recorded for patients that were regular attendees over the entire period 2009 to 2012 and consequently the outcome scores varied from 0 (no values recorded) to 4 (values recorded for each year). The independent variables used included age in 2009, duration of diabetes as at 2009, gender, past history of Myocardial Infarction and/or Ischaemic Heart Disease, comorbidity (yes/no) and treatment with insulin. Robust standard errors were used as patients were recruited to the study using a cluster sampling technique based upon the practice they attended. A 0.05 level of significance was employed and all statistical analysis was performed using STATA 12.0 [**26**].

Ethics:

Ethics approval from the Northern Sydney Local Health District Ethics Committee was obtained for the original study with an amendment to include the general practitioner survey approved in January 2015.

RESULTS

The number of T2D patients identified as regular patients in a particular calendar year increased dramatically over the period 2000 (261 patients) to 2007 (987 patients) with only a modest increase from 2008 (1,130 patients) to 2012 (1,298 patients). In 2012 the number of patients with T2D recruited from individual practices varied considerably with a range of 39 to 341 patients with a median of 81 patients.

In 2012, the average age of the patients was 63.5 years (*sd* 7.6 years), the median duration of diabetes was 7 years, 57.7% were male, 20.4 % had a comorbidity with 12.3% having ischaemic heart disease and 9.2% were on insulin therapy**. Figure 1** shows the trend in proportion of patients with T2D who had an annual data value for each of the five clinical parameters for each year between 2000 and 2012.

Figure 1: Percentage of T2D patients with annual data recorded in electronic medical record, 2000 to 2012.

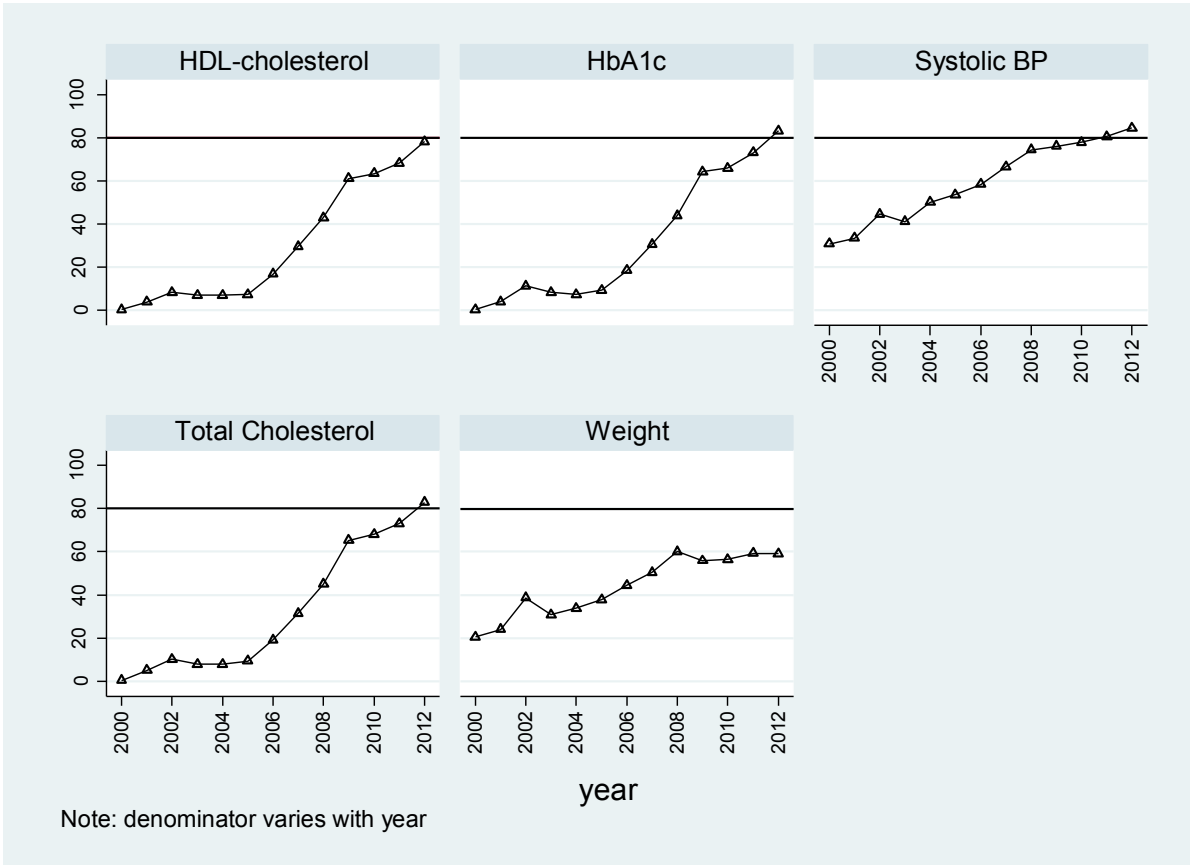
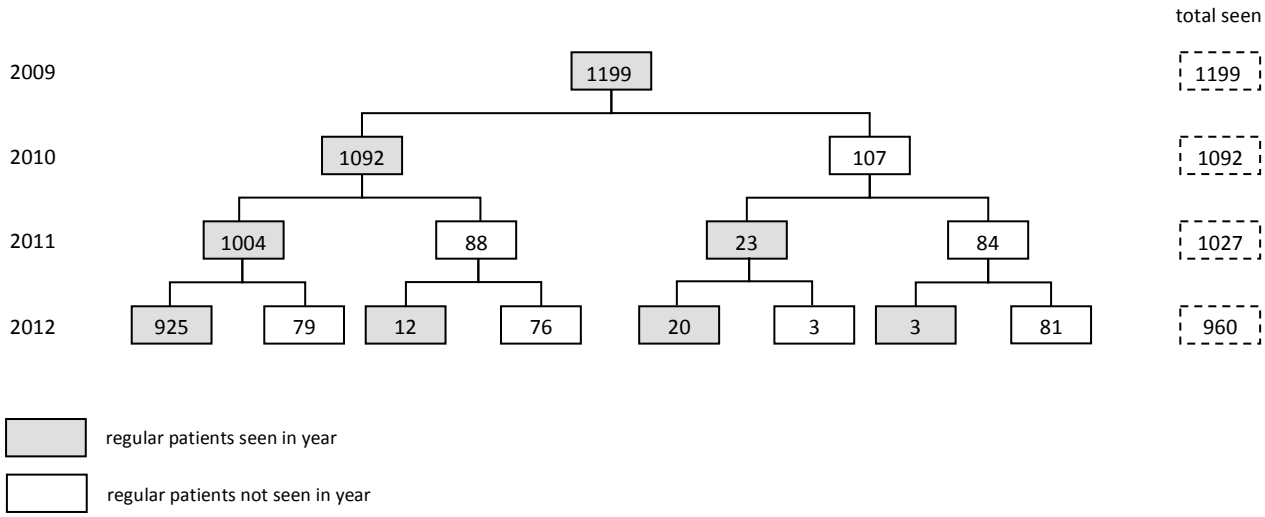


Figure 2 describes the follow-up of the 1199 regular patients included in the 2009 cohort that was analysed to test for temporal trends in data completeness and for associations between patient factors and data completeness.

Figure 2: 2009 Cohort of Regular Patients, number seen at a study practice each year, 2009 to 2012



Fixed Effects Analysis for 2009 patient cohort

Table 1 describes the proportion of data completeness for each of the clinical parameters by year and the odds ratios (ORs) for the availability of a clinical parameter in a given year (2010, 2011 or 2012) compared to 2009. Two hundred and forty individuals (20% of the cohort) that were regular patients in 2009 were no longer regular patients in 2012. The proportion of available data clearly increased with years up to approximately 80% with the exception of weight that remained below 60%. It can also be seen that the OR for 2012 was significantly elevated for HbA1c, Total-cholesterol, HDL-cholesterol and systolic blood pressure. For example, patients had 3.5 times the chance of having a HbA1c level available in 2012 compared with 2009. There was some evidence of an increasing trend in intervening years although this only reached significance for HbA1c and total cholesterol in 2011. There was no evidence of a significant change in the proportion of data completeness for weight over the period.

Table 1: Fixed Effects Analysis, Proportion of patients with available annual data for five clinical parameters, 2009 to 2012 , cohort of regular 2009 patients.

Measure	Year	No. T2D	%	OR	95% ci
HbA1c					
	2009	771/1199	64.3	1	
	2010	743/1092	68.0	1.1	0.86 - 1.3
	2011	767/1027	74.7	1.6*	1.3 - 2.1
	2012	812/960	84.6	3.5*	2.7 - 4.5
Total Cholesterol					
	2009	782/1199	65.2	1	
	2010	749/1092	68.6	1.0	0.82 - 1.3
	2011	750/1027	73.0	1.3*	1.1 - 1.7
	2012	816/960	85.0	3.3*	2.5 - 4.3
HDL- cholesterol					
	2009	732/1199	61.1	1	
	2010	695/1092	63.6	1.0	0.80 - 12
	2011	698/1027	68.0	1.2	0.98 - 1.5
	2012	775/960	80.7	2.8*	2.2 - 3.5
Systolic BP					
	2009	912/1199	76.1	1	
	2010	853/1092	78.1	1.0	0.80 - 1.3
	2011	832/1027	81.0	1.3	0.97 - 1.7
	2012	812/960	82.5	1.7*	1.3 - 2.4
Weight					
	2009	670/1199	55.9	1	
	2010	606/1092	55.5	0.9	0.71 - 1.1
	2011	593/1027	57.8	0.9	0.76 - 1.2
	2012	566/960	58.5	0.9	0.76 - 1.2

* statistically significant $p<0.05$

Ordinal Logistic regression analysis for 2009 patient cohort

Table 2 describes the data completeness scores for the 4 years between 2009 and 2012 for the cohort of regular patients in 2009 by the patient factors Ischaemic Heart Disease (IHD) and Insulin therapy. It demonstrates that patients with IHD had a significantly increased chance of having 4 annual systolic blood pressure measurements recorded compared to patients without IHD (OR 1.6, p=0.02). T2D patients receiving insulin had a significantly decreased chance of having 4 weight readings compared to a patient not receiving insulin (OR 0.59, p<0.01).

There were no univariate significant associations between age in 2009, duration of diabetes as at 2009, combined comorbidity or gender and data availability except for an association between a yearly increase in duration of diabetes and decreased HDL-cholesterol readings (OR 0.96, p<0.01).

The backward-selection multivariate analysis did not produce any models beyond the associations demonstrated at the univariate level.

Table2. Ordinal logistic regression, number of years with annual reading available, cohort of regular 2009 patients, Ischaemic Heart Disease and Insulin therapy.

parameter	patient factor	No. patients	% patients with score (no. annual values available)					OR	p-value
			0	1	2	3	4		
Systolic BP									
	IHD	109	2.8	0.9	8.3	17.4	70.6	1.6	**0.02**
	No IHD	816	6.1	4.4	9.8	19.1	60.5		
	Insulin	101	8.9	5.9	5.0	18.8	61.4	0.94	0.77
	No insulin	824	5.3	3.8	10.2	18.9	61.8		
Weight									
	IHD	109	11.9	11.0	22.0	19.3	35.8	1.38	0.09
	No IHD	816	14.2	16.5	19.7	22.1	27.5		
	Insulin	101	19.8	21.8	21.8	13.9	22.8	0.59	**<0.01**
	No insulin	824	13.2	15.2	19.8	22.7	29.1		
HbA1c									
	IHD	109	0.9	7.3	18.4	26.6	46.8	1.06	0.71
	No IHD	816	3.7	10.2	16.4	21.1	48.7		
	Insulin	101	4.0	8.9	10.9	30.7	45.5	1.01	0.95
	No insulin	824	3.3	10.0	17.4	20.6	48.8		
Total Cholesterol									
	IHD	109	1.8%	5.5%	18.4%	25.7%	48.6%	1.15	0.42
	No IHD	816	3.1%	11.3%	15.2%	22.9%	47.6%		
	Insulin	101	3.0%	8.9%	14.9%	28.7%	44.6%	0.97	0.86
	No insulin	824	2.9%	10.8%	15.7%	22.6%	48.1%		
HDL-Cholesterol									
	IHD	109	3.7%	7.3%	18.4%	29.4%	41.3%	1.2	0.28
	No IHD	816	4.7%	12.9%	17.4%	25.7%	39.3%		
	Insulin	101	5.0%	10.9%	16.8%	32.7%	34.7%	0.92	0.64
	No insulin	824	4.5%	12.4%	17.6%	25.4%	40.2%		

General Practitioner Questionnaire

There were 16 responses from 9 of the 12 practices with 3 responses the maximum from a single practice. All respondents indicated that their routine practice was to check blood pressure at least 6 monthly but only 6 checked weight at least 6 monthly. Glycated haemoglobin was checked at least 6 monthly by 14 practitioners with serum lipids (cholesterol, HDL-cholesterol and triglycerides) checked at least annually by all practitioners.

Three practitioners indicated that they would type free text into the "Today's notes" field to manually record information with the remainder indicating they normally used the relevant drop down menus. All respondents indicated that more than 75% of their laboratory test results were received electronically and incorporated into patients' records automatically. Eight practitioners indicated that they never entered any laboratory results manually. Three practitioners from two different practices responded that a nurse at their practice made clinical observations and entered these into the patient's record.

Table 3 presents the proportion of practitioners who strongly agreed or agreed with potential barriers to recording clinical information in a coded manner and some strategies to overcome these barriers. Overall the responses disagreed that the factors listed were barriers to recording clinical information in patient's electronic records. There was support for three of the four strategies to assist practitioners enter data.

Table 3: General Practitioner views on Barriers to recording of clinical data and potential strategies to overcome these barriers, N=16.

	strongly agreed /agreed (%)	**neutral/disagree/ strongly disagree (%)**
Barriers to recording clinical data		
Time Pressure prevents recording values	4 (25)	12 (75)
Drop down menu system complicated to use	3 (19)	13 (81)
Difficult to access past readings during consultation	0 (0)	16 (100)
Difficult to review changes in readings over time	1 (6)	15 (94)
Strategies to assist recording clinical data		
Pop up reminders if value not recorded within a given time period	15 (94)	1 (6)
Redesign layout of record screen	5 (31)	11 (69)
Practice nurse to routinely measure and record observations eg BP, weight	10 (63)	6 (37)
Audit records to provide feedback on completeness of recordings #	11 (73)	4 (27)

15 responses received.

DISCUSSION

This study demonstrated that over the period 2009 to 2012 the participating general practices increasingly recorded more readily accessible laboratory and blood pressure data in their electronic medical record systems for their regular T2D patients. This resulted in approximately 80% having data available on these parameters suitable for inputting into computer prediction models although the completeness of annual weight readings at around 55% remains a constraint.

The dramatic increase in the number of regular patients identified per calendar year in the early to mid 2000's is in keeping with the increase in the proportion of Australian general practitioners who reported using computerised system to record progress notes for their patients over this period (34% in 2001 (**27**) to 64% in 2005 (**28**)). Similarly, it was not surprising to see the substantial increase in availability of laboratory measurements over the study period as the documented proportion of Australian general practices that received or stored laboratory test results in their computerised medical systems increased from 54% in 2003 (**27**) to 79% in 2006 (**28**). With all 12 practices receiving and incorporating over 75% of their laboratory results electronically into patient records it is reasonable to assume that missing laboratory test data is most likely to be due to the patient not having undergone the test rather than it not being recorded. General practitioner knowledge of appropriate monitor frequencies for laboratory tests relevant to T2D was high in this study but this may not necessarily have transferred into implementation.

The relatively high proportion of available annual blood pressure readings and the suggestion of this increasing over time was encouraging. For these data to be available the practitioner must not only manually enter them (in contrast to laboratory data) but do so into the appropriate field within a patient's medical record rather than as free text within the "Today's notes" field. This finding suggests that general practitioners are changing their recording practices for data collected during physical examinations. Should this be the case, then the persistence of a figure of only 55% for the

availability of weight measurements implies that there is a specific barrier to patients having their weight measured in primary care rather than a problem recording the measurement.

The prevalence of co-morbidities may appear lower than expected although the proportion of patients with ischaemic heart disease was comparable with other Australian data published in 2009 (12.3 % compared with 15.7%) [29]. The under-reporting of comorbidities such as chronic kidney disease in electronic health records has been reported in previous studies and may have occurred [30].

From the practitioner survey it appears that clinicians are aware of the current monitoring guidelines for their patients with T2D and a lack of knowledge is unlikely to be the cause for sub-optimal recording of the clinical parameters reported. The finding that T2D patients with IHD are more likely to have their blood pressure recorded appears logical as current guidelines emphasise the need to optimise its control among patients with established cardiovascular disease [**31**]. However, it is counter intuitive that T2D patients on insulin therapy don't have their weight recorded as often as those not on insulin as suggested by this study. When interpreting the significance of this finding it should be done with the knowledge that weight recording for all patients with T2D in the study was well below what is recommended for routine management.

The practitioner survey suggested that practitioners were using their software's ability to readily access past results to monitor patient care and that the usability of the software was good. The strategies to further assist data recording that were identified are relatively straight forward to implement although the greater use of practice nurse time to measure and record clinical observations may have an opportunity cost.

The definition of a regular patient used in the study was an individual who had attended the same practice on two or more occasions during the same calendar year. This is somewhat more frequent that the standard definition used for a regular patient in Australia [**32]** but given that many clinical

parameters for T2D are recommended to be measured at least 6 monthly, a greater number of visits was deemed reasonable.

The major strength of this study is that it provides data collected outside of a formal clinical setting and as a result its findings are likely to be representative of the practitioners' data recording practices. The inclusion of practitioners' self-reported knowledge and habits complements the detailed quantitative analysis of extracted data and provide context to its interpretation.

There are several limitations to the study. Firstly, the identification of T2D patients relied on searching the "Past History" data table within Best Practice ^{TM} and HbA1c readings compared to more complex ontological approaches [**23**]. However, it is important to note that the "Past History" table includes both "reason for visit" and "past history "fields and that entries were searched for free text as well as coded values. Consequently the identification process was likely to have had adequate sensitivity. Secondly, the study outcome is the presence of a value and a formal check of its validity was not conducted. As such the increase in the proportion of recording of values may be of little benefit if there has been a commensurate decrease in validity or accuracy of the data recorded. However, this is unlikely to be a problem with laboratory results given the quality assurance processes laboratories routinely employ as part of their normal business processes.

Thirdly, the apparent increase in proportion of recorded readings has been confirmed by a fixed effect model for panel data. This analytic approach uses subjects as their own controls and assumes the characteristics of individual patients that may influence practitioners' behaviour don't vary over time [**25**]. Fourthly, the number of responses to the general practitioner survey was small. However, responses were obtained from 75% of practices that provided the electronic data for the study allowing its results to assist in the interpretation of the study's main findings.

Finally, the generalizability of the findings to other disease states and other software packages may be limited. The study only looked at one software package and differences between user interfaces and software functionality may well influence practitioner recording behaviours [16,17].

Computer models are being increasingly used to evaluate health care initiatives and becoming more sophisticated [**9**]. In order to maximise the potential from these approaches it is imperative that routine high quality data are available. This study demonstrates that the completeness of data in Australian general practice is improving although it is doing so from a relatively low base and the availability of historical data is somewhat limited. This study has only addressed one dimension of data quality and other dimensions such as accuracy, correctness and timeliness [**23**] need to be considered to fully assess the potential usefulness of applying computer model techniques to predict clinically significant outcomes for patients with T2D in the Australian general practice setting.

AUTHORSHIP

Michael Staff;

(1) contributed to the conception and design of the study, the acquisition of data, and the analysis and interpretation of data,

(2) drafted the article

(3) provided the final approval of the version to be submitted.

Lyn March;

(1) contributed to the conception and design of the study and interpretation of data,

(2) contributed to revising the article critically for important intellectual content

(3) provided final approval of the version to be submitted.

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(3) provided final approval of the version to be submitted.

STATEMENT ON CONFLICTS OF INTEREST

Conflicts of Interest: none

SUMMARY TABLE

What we already know

- primary care electronic medical record systems can provide input data for computer models to predict patient outcomes such as life expectancy
- primary care physicians use a combination of free text and coded data recording in electronic medical records
- free text recording poses a challenge for extracting data that are suitable as computer model inputs

What this study added to our knowledge

- primary care practitioners are improving coded data completeness of most parameters for patients with diabetes.
- some characteristics of patients with type 2 diabetes are associated with data completeness
- there are simple strategies that could be trialled to further improve coded data completeness

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APPENDIX - INSTRUMENT

GENERAL PRACTITIONER QUESTIONNAIRE – DATA RECORDING PRACTICES

Dear Doctor,

We would like to get your views on how your current medical record software (Best Practice) assists you in recording clinical parameters (eg weight, blood pressure, glycosylated Hb) for your patients with **STABLE** Type 2 Diabetes Mellitus.

Your responses will be anonymous and it should take 5 – 10 minutes to complete the survey.

Q1. Thinking about your usual practice how often do you measure/check the following clinical parameters for your patients with stable T2D ?

(Please tick one option for each parameter)

a. Blood Pressure
- o at each visit
- o 3 monthly
- o 6 monthly
- o annually
- o only when clinically indicated

b. Weight
- o at each visit
- o 3 monthly
- o 6 monthly
- o annually
- o only when clinically indicated

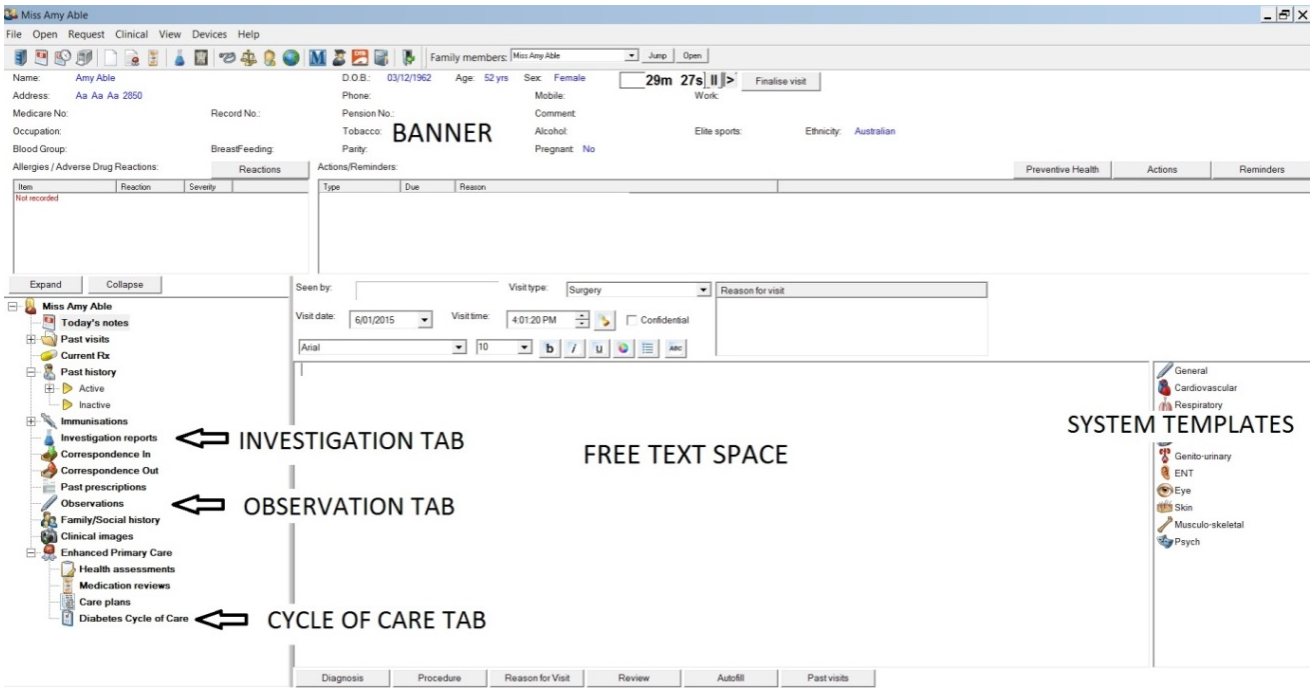
c. Smoking Status
- o 6 monthly
- o annually
- o only when clinically indicated

d. Glycosylated Haemoglobin (HbA1c)
- o 3 monthly
- o 6 monthly
- o annually
- o only when clinically indicated

e. Total Cholesterol, triglycerides & HDL-cholesterol
- o 6 monthly
- o annually
- o only when clinically indicated

f. Albuminuria (laboratory assay) /eGFR
- o annually
- o every 2 years
- o only when clinically indicated

Q2 Below is a "screen shot" of a patient record from Best Practice Software to assist answering the next few questions about how you record clinical data for your T2D patients.



a. How do you usually record information on blood pressure and weight for your T2D patients?

(please tick response that applies -you can have multiple responses)

- Type directly into the "Free Text space" within "Today's notes"
- Use the "system templates" on the RHS of "Today's notes"
- Use the "observation" tab on the LHS
- Use the "Diabetes Cycle of Care" tab on the LHS at the bottom

b. How do you record information on Smoking Status for your T2D patients?

(please tick response that applies -you can have multiple responses)

- Type directly into the "Free Text space" within the "Today's notes"
- Alter smoking status on the "Banner"

c. <u>IN ADDITION</u> to electronically receiving laboratory investigation results (HbA1c, lipids, albumin) into your record system from your pathology provider which of the following methods do you use to record results for your T2D patients?

(please tick response that applies -you can have multiple responses)

- Type directly into the "Free Text space" within "Today's notes"
- Use the "Investigation" tab on the LHS
- Use the "Diabetes Cycle of Care" tab on the LHS at the bottom
- Don't usually record any additional results

Q3 How often do you record the clinical data (excluding results directly received from laboratory tests) referred to in Q2 in your patient's electronic clinical record; *(Please tick one option)*

- o each time it is measured
- o only if it has not been recorded recently
- o only if it is abnormal
- o never

Q4 Are there any significant barriers to you recording values into the patient's medical record?

- o Yes – **please go to Q5**
- o No – **please skip Q5 & go to Q6**

Q5 Thinking about the barriers to recording values please indicate whether you agree or disagree with the following statements;

(Please circle option that best describes your opinion)

a. Time pressure often prevents me recording values

Strongly Agree Agree Neutral Disagree Strongly Disagree

b. Best Practice Software is NOT user friendly and makes it complicated to record values

Strongly Agree Agree Neutral Disagree Strongly Disagree

c. It is difficult to access past readings during consultations so there is little point in recording values

Strongly Agree Agree Neutral Disagree Strongly Disagree

d. **Other barriers** – Please describe

Q6 What potential strategies do you think would be useful to assist you to record values?

(Please circle option that best describes your opinion)

a. Pop up reminders if values have not been recorded within a given time frame

Strongly Agree Agree Neutral Disagree Strongly Disagree

b. Redesigning layout of medical record screen

Strongly Agree Agree Neutral Disagree Strongly Disagree

c. Get your Practice nurse to routinely check and record basic observations

Strongly Agree Agree Neutral Disagree Strongly Disagree

d. Regular (say 6 monthly) automated audits of records to identify recording gaps

Strongly Agree Agree Neutral Disagree Strongly Disagree

e. **Other** – please describe

Thank you for completing this questionnaire.

Please contact xxx should you have questions or concerns about the questionnaire.