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Prescribing History to Identify Candidates for Chronic Condition Medication Adherence Promotion

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Abstract. Poor adherence to long-term prescription medication is a frequent problem that undermines pharmacological control of important risk factors such as hypertension. A medication possession ratio (MPR) can be calculated from Practice Management System (PMS) data to provide a convenient indicator of adherence. We investigate how well prior MPR predicts later MPR, taking MPR<80% as indicative of 'non-adherence,' to assess the potential value of MPR calculation on PMS data for targeting adherence promotion activities by general practices. We examine PMS data for two New Zealand metropolitan general practices, one with a predominantly Pacific caseload, across 2008 and 2009. We find prevalence of non-adherence in 2009 to be 51.63% (95% confidence interval [CI] 47.9-55.3) for patients at the Pacific practice and 28.09% (95% CI 25.0-31.1) at the other practice for patients who are demonstrably active with the practice in 2009. The positive predictive value (PPV) of 2008 non-adherence for 2009 non-adherence is 71.80% (95% CI, 66.5-77.1) and negative predictive value (NPV) 61.52% (95% CI 56.9-66.1) for the Pacific practice; PPV is 61.38% (95% CI 54.6-68.2) and NPV is 82.19% (95% CI 79.2-85.2) for the other practice. The results indicate good potential for decision support tools to target adherence promotion.

Keywords. Hypertension, information systems, patient non-adherence, quality indicators.

1. Introduction

In this paper, we take *adherence* as the extent to which a patient's behavior in taking prescribed medications aligns with the instructions and recommendations from the prescriber [1]. Poor adherence to antihypertensive medications is commonplace, even where cost is not a major concern; for example, a Swedish study found satisfactory refill adherence for major classes of antihypertensive agents to be from 55% to 66% [2]. Despite this, providers do not routinely ask about adherence, are often unaware of poor adherence and do not take it into account when titrating dose [3]. We take a particular interest in Pacific adherence to antihypertensive medication. The Pacific population in

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New Zealand (NZ) has grown dramatically since World War II, from 2,200 people in 1945 to 266,000 in 2006, with 66% living in the Auckland metropolitan area and Samoan being the largest Pacific ethnic group [4]. This Pacific population has a greater cardiovascular disease (CVD) risk than European New Zealanders [5].

Our research has focused on use of Practice Management System (PMS) records to examine quality of long-term condition management in general, and adherence to long-term medications in particular. NZ ranks well for information technology use in General Practice medicine [6]; individual practices have ready access to their prescribing records and can potentially use these to be more aware of their patients' adherence. While prescriptions provide an indirect measure of adherence (as compared to dispensing or consumption), we find 93% of prescriptions for long-term medication to be matched within a week by a dispense in NZ national claims data [7]; and we find prescribing based adherence to be associated with significantly increased odds of meeting recommended blood pressure (BP) targets for patients with diabetes [8]. We have used PMS data to identify Samoan patients for study of their perspectives on antihypertensive medication adherence [9], and recently for recruiting patients to a feasibility study of adherence promotion by General Practice staff.

If past prescribing records are to be useful in targeting medication adherence promotion, however, we are left with a question: just how well does poor adherence from past prescribing data predict later adherence? In the next section, we describe our software tools, data and protocol for the present study addressing that question. We then give the results and in the discussion section focus on the implications of the patterns we find for practical use of PMS data in promotion of patient adherence.

2. Methods

2.1. Analysis Software

We have created a platform for analysis of long-term condition management from PMS data, called ChronoMedit (described in depth elsewhere [10]). ChronoMedit has an ontology of PMS data concepts, including a hierarchy of antihypertensive medications, and is designed to answer several specific classes of query, including queries about continuity of medication supply. We use Medication Possession Ratio (MPR) – percent of days a patient is in supply of a medication – as a key statistic, and choose the common threshold of MPR<80% as defining poor (or 'non-') adherence. Antihypertensive MPR is calculated with the model that a patient is 'in supply' on a given day if issued a prescription that provides supply on that day if dispensed on the day prescribed and thereafter taken as directed. We consider a patient adherent if they have *any* antihypertensive supply (ignoring partial non-compliance to combination therapy involving multiple types of pills) and disregard stockpiles. Figure 1 shows a ChronoMedit timeline graph illustrating poor adherence for a 12-month evaluation period (EP) starting 1 January 2008. The figure shows a 6-month 'run-in' period; a prescription in the run-in may provide supply into the EP.

2.2. Data

Ethics approval was given by the NZ 'Northern X' Regional Ethics Committee (protocol NTX/09/100/EXP). Herein we analyse PMS data from two Auckland

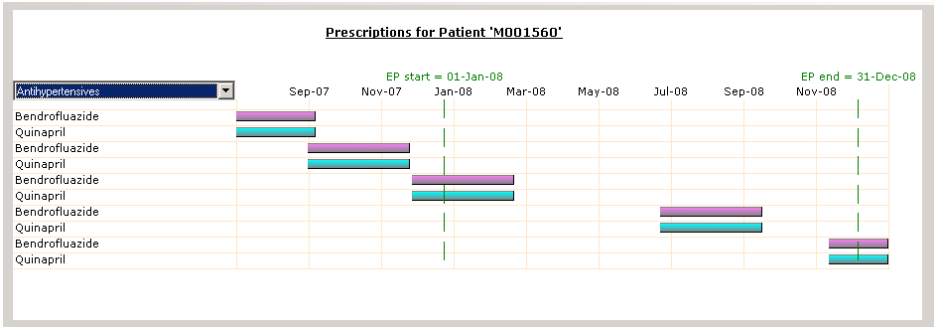

Figure 1. ChronoMedit timeline graph for a patient with poor adherence.

metropolitan general practices: Practice One, which focuses on a Pacific clientele, and Practice Two with a relatively typical Auckland caseload. De-identified data extracts were made in June 2010 and include data from 1 July 2007 on prescriptions, lab tests, BP measures and diagnoses, as well as ethnicity of 'funded' patients (NZ residents are encouraged to enroll with one primary health organization which is provided partial subsidy for their care). Patients were included for analysis if they had at least one antihypertensive prescription in the period 1 July 2007 to 31 December 2008 and were over age 20. Prescriptions from 1 July 2007 were used as run-in for MPR calculations on the calendar years of 2008 and 2009.

Due to the practice-specific nature of our data, a zero MPR may occur when the patient is adherent but now using another provider. As such, it is relevant to know whether the patient is still in some sense active with the practice. We define a patient as "active" for 2009 if they have any prescription, BP measurement, diagnosis, or any of the lab tests we capture (cholesterol, HbA1c, ACR, microalbumin, creatinine, uric acid, eGFR, or fasting glucose) recorded in the PMS during that year.

2.3. Protocol

We examine the distribution of 2009 adherence with respect to 2008 data for both practices. The proportion of patients non-adherent in 2008 that are still non-adherent in 2009 can be interpreted as the positive predictive value (PPV) of detecting ongoing adherence problems. Similarly, the proportion adherent in 2008 still adherent in 2009 is the negative predictive value (NPV). If it is to be valuable, PPV should exceed the overall prevalence of non-adherence in the later timeframe (i.e. reduced false positive, FP, rate as compared to providing adherence promotion to everyone). We look at the relationship of 2008 and 2009 adherence for just those patients active with the practice in 2009 as well as for the total of all patients. Reported confidence intervals (CIs) for proportions use standard Gaussian approximation.

3. Results

Table 1 shows the ethnicity code distribution for the funded patients over age 20 at each practice. 842 and 921 patients in Practice One and Practice Two, respectively, met the inclusion criteria for analysis of their antihypertensive adherence. Table 2 shows the distribution of adherence outcomes for the calendar years 2008 and 2009. This shows that for each practice, for total patients as well as just those active in 2009, the

PPV of 2008 non-adherence significantly exceeds the 2009 prevalence of non-adherence. Note that counts of patients that were inactive, and thus have MPR=0, in 2009 are the differences of the Total and Active groups (e.g. there were 27 [184 minus 157] patients at Practice One that were adherent in 2008 and then inactive in 2009).

Table 1. Self-identified ethnicities by practice[1]

Practice One		Practice Two	
Pacific		European	3107 (83%)
Samoan	1988 (79%)	NZ Maori	366 (10%)
Cook Island Maori	118 (5%)	Asian	86 (2%)
Niuean	116 (5%)	Pacific	85 (2%)
Tongan	98 (4%)	Other	78 (2%)
Other Pacific	24 (1%)		
NZ Maori	72 (3%)		
European, Asian & Other	86 (3%)		

[1]Individuals may claim up to 3 ethnicities, the first supplied ethnicity is used here

Table 2. 2009 adherence by 2008 adherence: count, row percentage and 95% CI of row percentage

2008	2009			
	Active		Total	
	Adherent	Non-adherent	Adherent	Non-adherent
Practice One				
Adherent	251 (61.52%) [56.9%-66.1%]	157 (38.48%) [33.9%-43.1%]	251 (57.70%) [53.2%-62.2%]	184 (42.30%) [37.8%-46.8%]
Non-Adherent	75 (28.20%) [22.9%-33.5%]	191 (71.80%) [66.5%-77.1%]	75 (18.43%) [14.7%-22.1%]	332 (81.57%) [77.9-85.3%]
Total	326 (48.37%) [44.7%-52.1%]	348 (51.63%) [47.9%-55.3%]	326 (38.72%) [35.5%-41.9%]	516 (61.28%) [58.1%-64.5%]
Practice Two				
Adherent	503 (82.19%) [79.2%-85.2%]	109 (17.81%) [14.8%-20.8%]	503 (79.59%) [76.5%-82.7%]	129 (20.41%) [17.3%-23.5%]
Non-Adherent	73 (38.62%) [31.8%-45.4%]	116 (61.38%) [54.6%-68.2%]	73 (25.26%) [20.4%-30.2%]	216 (74.74%) [69.8%-79.6%]
Total	576 (71.91%) [68.9%-75.0%]	225 (28.09%) [25.0%-31.1%]	576 (62.54%) [59.5%-65.6%]	345 (37.46%) [34.4%-40.5%]

4. Discussion and Conclusion

It is unsurprising (e.g. from [1]) that analysis of PMS prescription data indicates high rates of poor medication adherence; this is a major population health issue generally, and particularly so for the Pacific population. Given the complex psychosocial basis of non-adherence, however, it is surprising that there is as much change in patient status from one year to the next as we observe.

Use of the results for adherence promotion depends on the intervention. For an intensive promotion (e.g. counseling and education, dose simplification and support for medication administration), any reduction in FP rate (i.e. intervening on patients who would have been adherent anyway) represents considerable savings. For an inexpensive screening, such as brief conversation with practice staff, or a questionnaire in the waiting room as a precursor to more intensive intervention, the benefit of preventing an FP is less. Even in the screening context, however, PMS data could be useful: MPR<80% is difficult to dismiss without a clear reason (e.g. a prolonged hospital stay);

and patients with poor past adherence and now inactive warrant phone contact to determine if they have transferred care.

The value of prescribing history decreases as overall prevalence of non-adherence increases – in Practice One there is only around a 20% reduction in FP rate in using past non-adherence as a predictor as compared to assuming everyone non-adherent, whereas the FP reduction is 33% in Practice Two. Practices should adjust intervention strategies to their prevalence rates. Since adherence promotion is just one of many demands on the health workforce, automated methods, such as cell phone based reminders, are an attractive option. MPR<80% is a good candidate as an invocation criterion for such services. Patients could be shown something like Figure 1 to explain why they have been contacted. Study limitations include the use of data from just two practices, each with distinct caseloads. Correlation to national databases (pharmaceutical claims, hospital admissions, mortality) would remove much of the uncertainty in looking at practice data alone; and if this could be done in near real-time via a national e-pharmacy network it would save practices from many FP follow-ups.

In conclusion, high rates of poor adherence are indicated in analysis of PMS prescription data for antihypertensive medications. Poor adherence in one year is predictive, although far from perfectly, of poor adherence the next. Thus, practices wishing to target their adherence promotion efforts would potentially benefit from decision support tools that use past prescribing records to compute MPR.

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