Effectiveness of a Chronic Disease Surveillance Systems for Blood Pressure Monitoring

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Abstract

Information Technology (IT) enables health care providers to manage patients with chronic conditions through identification, follow up and administration of specific interventions. In our setting, we developed a surveillance system for chronic diseases. The aim of this study was to show its efficacy on monitoring blood pressure throughout a cluster randomized controlled trial. Patients without blood pressure registries (condition 1) or with high blood pressure measurements (condition 2) were randomized to be detected by the surveillance system or to receive usual care. The proportion of patients with at least one blood pressure measurement within three months of follow up was 49.9\% (207 patients) in the intervention group and 37\% (195) in the control group (p<0.001) for condition 1. And 61\% (224) vs. 50\% (239) respectively (p=0.002) for condition 2. Patients under the surveillance system have higher proportion of blood pressure measurements, showing this study an improvement on the process of care with this IT tool.

Keywords:
Hospital Information Systems; Chronic Disease; Hypertension; Disease Management; Medical Records Systems, Computerized; Population Surveillance; Randomized Controlled Trials.

Introduction

Chronic conditions are the major cause of illness, disability and death in Argentina like in other countries [1, 2]. Attempts to accomplish an effective control of chronic prevalent diseases are nowadays mandatory. In Argentina, studies performed in different socio-economic levels, showed that hypertension control is heterogeneous and not always done [3, 4]. Information systems generally offer a number of benefits in health care. Chronic Disease Management Systems (CDMS) are an effective information technology tool to improve the management of chronic diseases. CDMS enable health care providers to manage patient with chronic conditions such as hypertension, diabetes or asthma [5].

From an epidemiological point of view a CDMS might help to perform epidemiological surveillance. This means the ongoing, systematic collection, analysis, interpretation, and dissemination of data, being the ultimate aim of all surveillance systems, the disease control [6].

Similar to the surveillance of infectious and other acute disease, surveillance for chronic diseases has been largely implemented [7, 8]. Until now for chronic diseases surveillance systems did not allow the quick identification and intervention of detected uncontrolled cases, as has been achieved in acute diseases.

Our setting, a Health Maintenance Organization (HMO) (Plan de Salud del Hospital Italiano de Buenos Aires), is an University Hospital based prepaid health care system. The Hospital is a 650 beds tertiary center with high standards in quality of health care and information systems [9-12]. To achieve control of chronic conditions we started in August 2000 a Disease Management Program (DMP) which its efficacy for hypertension control has already been demonstrated [13]. To improve DMP performance we developed in the year 2005 a surveillance system to detect and rapidly intervene patients with chronic disease [14].

The aim of this study is to show the efficacy of our surveillance system as a strategy for improving the performance of the hypertension care process.

Materials and Methods

Study design

We performed a cluster randomized pragmatic controlled trial

Setting

In our HMO around 140.000 middle class residents of Buenos Aires are attended. Most of the HMO health care system is based on primary care physicians (PCP). Primary care is capitated and delivered at the Hospital and/or at any of the twenty four HMO’s peripheral outpatient care centers.
The total number of PCPs working in our HMO is 182, taking care of 50,110 patients with chronic conditions (average capita 735 patients ranging from 80 to 1415 patients).

**Randomization**

PCPs with more than 100 capitated patients were included in randomization.

Patients without blood pressure registries (see rules below) seeking for an appointment with their PCP on the following 15 days were prospectively randomized.

In order to achieve a balanced randomization, physicians were stratified in three categories according to the number of appointments scheduled: >5 to <10, > 10 to < 15 and > 15.

Within each strata, physicians were categorized in a random way to be 0 (not included in the surveillance system=control group) or 1 (enrolled in the surveillance system=intervention group).

Finally, according to their physician allocation number (0 or 1) patients were (or were not) enrolled in the surveillance system.

Patients allocated to the intervention group were detected by 2 conditions, in condition 1 were patients without blood pressure registries, and in condition 2 were patients with high blood pressure measurements, and listed for the DMP by the system every time they ask for physician’s appointments while those in the control group were not listed during the 3 months of the study period. (Figure 1)

**Sample size**

Required sample size was 2200 patients, calculated to detect a difference of 10% in the proportion of patients with their blood pressure measured, considering an alpha error of 1%, a power of 80%, and a desire precision of 2%. We multiply by a design effect of 1.3 to adjust for the additional variability of the cluster design. 88 clusters were needed.

**Study outcomes**

According to the standard outcome metrics for disease management programs published by the Disease Management Association of America[15], patients with chronic conditions must have their blood pressure measured at least once every 6 months, and uncontrolled hypertension patients must have this measurement done in every physician encounter.

Main outcome measure was the proportion of patients with at least one blood pressure measurement during the three months period, among those patients identified by the system according to the above criteria.

The main outcome was expressed separately for patients without registries during the last 6 months (condition 1) and for patients with uncontrolled hypertension (condition 2).

Secondary outcomes were mean systolic and diastolic blood pressures.

**Statistical Analysis**

Means and proportions are shown with their respective standard deviations (SD) and 95% confidence intervals (95% CI) respectively. Comparability of baseline and pre-post intervention characteristics was ascertained by T test (either for single or paired samples) for continuous variables and Chi square test for proportions. The significance was considered at 1% level.

Intention-to-treat analysis was performed maintaining patients in their original groups. We used STATA 8 to perform the statistical analysis.

**Intervention group**

These patients were identified by the surveillance system and were followed by their PCP (usual care) and by the disease management program.

**Surveillance system:**

**Patient Identification:** the Master Patient Index (MPI) is the cornerstone of our health Information system[16]. Since 1999 our HMO has an Electronic Health Record (EHR) that is used by all physicians[12, 17]. Every entry in the record system, including pharmacological prescriptions and studies ordered (physician order entry), have to be attached to a medical problem. Each medical problem, diagnoses, risk factors and past history are automatically codified using terminological service based on SNOMED CT as referent vocabulary[18, 19].

The surveillance system uses information from two different sources:

1- EHR (medical problems, laboratory results, vital signs, pharmacological prescriptions)

2- Appointment Scheduling Software

**Follow up:** With data provided by this sources the surveillance system generates different surveillance lists (Figure 2), being patients classified as:
• Not needing active intervention: hypertensive patient with blood pressure measurements recorded in EHR over the last six months with values under 140/90, or 130/80 in case of known diabetes.

• Patients to be enrolled: uncontrolled hypertensive patient (>140/90) or smokers or incident stroke not yet included.

• Patients already enrolled with interventions pending: hypertension patient without blood pressure measured in the last 6 months.

There are more than 10 rules running on our system to identify different medical conditions. In this study we tested the below two rules:

- Patients without blood pressure measurement in the last 6 months (condition 1)
- Patients with a high blood pressure measurement in the last appointment (condition 2)

Surveillance lists were daily matched with the Appointment Scheduling Software.

Appointments from the identified patients were marked generating a remainder for the receptionists so that they sent patients to program’s office before physicians’ visits.

**Disease Management Program**

Once in the program office, assistants measured and recorded risk factors, blood pressure, weight and height. They reminded patients, verbally and with specially designed leaflets, to record their blood pressure weekly, to keep lifestyle changes and to comply with pharmacological treatment. They also invited patients to attend educational sessions that were previously demonstrated to be efficacious [20]

All this data was systematically recorded on the EHR before physician appointments so that PCPs count on with this information

**Control group**

Patients in this group received usual care. This included health care administered by their PCP and by Disease Management Program only under PCPs request.

**Results**

A total of 2315 patients were included, 1011 were randomized to the intervention, and 1304 to usual care. 67% attended to the scheduled appointment in both groups. Among them the median number of visits to primary care physicians was 1.93 (1.35) for the intervened group and 1.71 (SD 0.88) in the control group (p < 0.01) over the follow up period.

There were no statistical significant differences in basal characteristics between groups as is shown in table 1. 20% of patients control group were referred to the disease management program by their PCP.

Among those who fulfilled criteria for condition 1, there were 207 (49.9% with 95% IC from 45 to 55%) patients that had their blood pressure measured in the intervention group and 195 (37% with 95% IC from 33 to 41%) in the control group (p<0.001).

Among those who fulfilled criteria for condition 2, there were 224 (61%) patients that had their blood pressure measured in the intervention group and 239 (50%) in the control group (p=0.002).
Table 1 – Basal Characteristics

<table>
<thead>
<tr>
<th>Variables</th>
<th>Intervention Group (N=1011)</th>
<th>Control Group (N=1304)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age in years (SD)</td>
<td>73 (10.54)</td>
<td>73.77 (9.58)</td>
<td>0.73</td>
</tr>
<tr>
<td>Women, n (%)</td>
<td>661 (65.4)</td>
<td>846 (64.9)</td>
<td>0.801</td>
</tr>
<tr>
<td>Patients with hypertension, n (%)</td>
<td>919 (90.9)</td>
<td>1181 (90.6)</td>
<td>0.784</td>
</tr>
<tr>
<td>Patients with diabetes, n (%)</td>
<td>168 (16.6)</td>
<td>224 (17.02)</td>
<td>0.721</td>
</tr>
<tr>
<td>Patients with cardiovascular disease, n (%)</td>
<td>74 (7.3)</td>
<td>70 (5.4)</td>
<td>0.054</td>
</tr>
<tr>
<td>Patients with lipid disorders, n (%)</td>
<td>536 (53.0)</td>
<td>713 (54.7)</td>
<td>0.426</td>
</tr>
<tr>
<td>Patients with Stroke, n (%)</td>
<td>57 (5.6)</td>
<td>59 (4.5)</td>
<td>0.223</td>
</tr>
<tr>
<td>Smoker Patients, n (%)</td>
<td>214 (21.6)</td>
<td>260 (19.9)</td>
<td>0.468</td>
</tr>
<tr>
<td>Ex smoker Patients, n (%)</td>
<td>30 (3.0)</td>
<td>31 (2.4)</td>
<td>0.379</td>
</tr>
<tr>
<td>Mean Basal Systolic Blood Pressure, condition 2 (SD)</td>
<td>152.78 (14.06)</td>
<td>153.80 (13.32)</td>
<td>0.193</td>
</tr>
<tr>
<td>Mean Basal Diastolic Blood Pressure, condition 2 (SD)</td>
<td>82.15 (11.15)</td>
<td>83.17 (10.58)</td>
<td>0.103</td>
</tr>
</tbody>
</table>

Although we were able to show improvement in process outcomes we could not found differences on clinical outcomes between groups. Several reasons could explain this discrepancy: this was a short term study (3 months), usually not enough to obtain clinical outcomes results. As PCPs' usual care in our Hospital includes sending patients to DMP, and there was a significant proportion of patients in the control group that actually received the intervention (20 % contamination). Also it has already been shown more variability on outcome process than on clinical outcomes.

In previous reports, chronic disease management systems are shown as an IT tool that could replace an EHR[5], we think that this kind of surveillance systems must exist immerse in a health information system like a whole, and the basic requirements that those IT application should have are:

- Identify, trace and continuously monitor chronic ill patients to obtain a well cared population. Alert those patients reluctant to receive health care.
- Rank possible treatments, pharmacological and educational interventions, in terms or their greatest potential impact on outcomes.
- Keep adherence along time in these chronic and asymptomatic conditions. Include IT solutions to schedule and remind preventive and needed interventions intelligently tailored to each patient profile

Further issues concerning the identification of barriers to comply with this chronic care model either from patients or physicians points of view should be studied and address.

References

[7] Canada PHAo. Chronic Disease Surveillance in Canada: Health Surveillance Coordination Division,Centre for


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