Intervention to reduce the use of unsafe abbreviations in a teaching hospital

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Abstract Objectives: To determine the effectiveness of a two-phase intervention designed to reduce the use of unsafe abbreviations.

Methods: An observational prospective study was conducted at the King Khalid University Hospital in Riyadh, Saudi Arabia during May–September 2009. A list of unsafe abbreviations was formulated based on the recommendations of the Institute for Safe Medication Practices. The first 7000 medication orders written at the beginning of each period were collected. Phase one of the intervention involved educating health care professionals about the dangers of using unsafe abbreviations. In the second phase of the intervention, a policy was approved that prohibited the use of unsafe abbreviations hospital-wide. Then, another educational campaign targeted toward prescribers was organized. Descriptive statistics are used in this paper to present the results.

Results: At baseline, we identified 1980 medication abbreviations used in 7000 medication orders (28.3%). Three months after phase one of the intervention, the number of abbreviations found in 7000 medication orders had decreased to 1489 (21.3%). Six months later, after phase two of the intervention, the number of abbreviations used had decreased to 710 (10%). During this phase, the use of all abbreviations had declined relative to the baseline and phase one use levels. The decrease in the use of abbreviations was statistically significant in all three periods (P < 0.001).

Conclusion: The implementation of a complex intervention program reduced the use of unsafe abbreviations by 65%.

1. Introduction

Approximately 5% of the medication errors reported in the United States are attributed to the use of unsafe abbreviations (Brunetti et al., 2007). Unsafe abbreviations are also known as error-prone abbreviations because orders may be misinterpreted, resulting in patient harm (Koczmara et al., 2005).
Focusing on the word “error” draws attention to the question of prevention: the issue of what can be performed to minimize mistakes and improve patient safety. In managing the use of medications within hospitals, we aim to ensure that the “five rights” are achieved: that the correct patient receives the right dosage of the right drug via the correct route at the right time (Benjamin, 2003). Techniques used to prevent medication errors in hospitals include the use of information technology and automation, the establishment of medication safety programs, and the participation of pharmacists in the medication monitoring process (Committee on Identifying and Medication Errors, 2006; Bates et al., 1998; Poon et al., 2006; Cohen et al., 2005; Vira et al., 2006; Nester and Hale, 2002; Bond et al., 2000, 1999, 2002; McFadzean et al., 2003; Strunk et al., 2008). However, low-cost solutions such as the non-use of unsafe abbreviations may also help to prevent medication errors.

An abbreviation can be misinterpreted for a variety of reasons. It may have more than one meaning, it may be unfamiliar to the reader, or if poorly written, it may be mistaken for another abbreviation (Cohen, 2007). When simple abbreviations are either inadvertently misused by prescribers or misunderstood by pharmacists and/or nurses, the wrong drug can be administered. For example, “MS” can be used as an abbreviation for either magnesium sulfate or morphine sulfate. The use of the abbreviation “u” is also responsible for numerous medication errors (Institute of Safe Medication Practices. USP-ISMP Medications, 1971). This abbreviation, which stands for “units”, is often used for high-alert drugs such as Heparin and Insulin, which require special instructions and precautions. If a prescriber writes in a prescription that “4u” of regular insulin are to be administered but the “u” looks like a 4 to the nurse or pharmacist, the patient might be administered 44 units of Insulin instead of 4 units (Paparella, 2004).

The Joint Commission and the Institute for Safe Medication Practices publish a “do not use” list of unsafe abbreviations, symbols, acronyms and dose designations (Brunetti, 2007; Lucci, 2004). In the United States, several studies have implemented interventions designed to reduce the use of unsafe abbreviations (Garbutt et al., 2008; Abushaiqa et al., 2007; Myers et al., 2011). To our knowledge, however, no study has been conducted in another country that has evaluated interventions intended to reduce the use of unsafe abbreviations. The objectives of the current study were thus to estimate the prevalence of the use of unsafe abbreviations and to determine the effectiveness of a two-phase intervention program designed to reduce the use of unsafe abbreviations in a teaching hospital in Riyadh, Saudi Arabia.

2. Methods

2.1. Design and setting

This observational prospective study was conducted in three phases: a baseline phase, a phase three months after the intervention, and a phase six months after the intervention. We collected the first 7000 medication orders written at the beginning of each period (usually during approximately one week).

This study was conducted at the King Khalid University Hospital in Riyadh, Saudi Arabia. This is a tertiary teaching hospital affiliated with King Saud University. With more than 1000 beds, the hospital generally averages 800 patients in non-intensive care and more than 100 patients in surgical, medical and cardiac intensive care units (ICUs). The patient population is comprised predominantly of local citizens. Medical care service is provided by attending physicians, registrars, medical residents, interns, and students. The study was conducted over a six-month period in 2009 (May through September). Ethical approval for this study was obtained from the Institutional Review Board (IRB) at the King Khalid University Hospital.

2.2. Baseline use of unsafe abbreviations

Based on the recommendations of the Institute for Safe Medication Practices, a list of unsafe abbreviations was formulated (Institute for Safe Medication Practices. ISMP Error-Prone, 2011). This list included the use of “U” for units, “µg” for micrograms, “QOD” for every other day, “MS” for Morphine Sulfate or Magnesium Sulfate, trailing zeros after a decimal point, the symbol “>” for greater than, apothecary units as a substitute for metric units, the symbol “@” for “at”, “CC” for mL, “IU” for “international units”, and “DC” for “discontinue” or “discharge”. The first 7000 medication orders were collected and examined for the presence of any of these abbreviations. Research assistants with a background in health (as pharmacy technicians or nurses) conducted the analysis of the orders. All abbreviations found were marked and recorded in a data collection sheet.

2.3. Intervention

Three months after the baseline data on the use of unsafe abbreviations had been collected, the phase one intervention commenced. The aim was to educate health care professionals about the danger of using unsafe abbreviations. The intervention included posters in all wards, medical chart dividers, in-service education programs in all wards, and a medication safety day attended by the hospital’s physicians. Three months after the start of the intervention, the use of unsafe abbreviations was assessed using the same methodology as was used during the baseline phase. A critical step during phase two of the intervention was the approval of a policy prohibiting the use of unsafe abbreviations hospital-wide; the hospital administration distributed this policy to prescribers. Phase two also included another educational campaign for prescribers. Three months later, another assessment of the use of unsafe abbreviations was conducted.

2.4. Data analysis

Data were collected on the types of abbreviations used and the number of abbreviations per medication order. Information on prescriber rank was collected for a subset of the baseline data. Descriptive statistics were used to present the results. Tukey and Bonferroni were used to compare the use of unsafe abbreviations in the different periods. Version 17 of the Statistical Package for Social Science (SPSS) software was used for the analysis.
3. Results

During the baseline phase, 1980 medication abbreviations were used in 7000 medication orders (28.3%) (Fig. 1). These abbreviations were used mainly by interns (41%), residents (33.6%), registrars (22%), and a few consultants (3.2%). The most common abbreviations used were “cc” instead of “mL” (50%), “@” instead of “at” (34%), and “DC” instead of “discontinue” (32%) (Table 1).

Three months after the phase one intervention, the number of abbreviations found in 7000 medication orders had decreased to 1489 (21.3%), and the most common abbreviation used was “cc” instead of “mL” (51%). Interestingly, although the total number of abbreviations decreased, the use of some abbreviations increased. These abbreviations included “@”, which was used instead of “at” (with an increase from 680 to 713), and “>”, which was used instead of “greater than” (with an increase from 112 to 274).

Six months later, after phase two of the intervention, the number of abbreviations used had dropped to 710 (10%). All abbreviations in this phase were used less often than during the baseline phase and phase one. Interestingly, five abbreviations were not used at all, and two of these were used in both the baseline phase and the first phase. The latter two were “MS”, used instead of Morphine Sulfate or Magnesium Sulfate (which appeared in 5% of the sample at the baseline), and “DC”, used instead of “discontinue” (which appeared in 32% of the sample at the baseline). The decrease in the use of abbreviations from period to period was statistically significant in both cases ($P < 0.001$). For all three periods, we found that approximately 60% of the time, only one abbreviation was included in each medication order; approximately 30% of the time, two abbreviations per order were used (Table 2).

4. Discussion

We found that the baseline rate of use of unsafe abbreviations was 28.3%. After three months of phase one intervention, the use of these abbreviations decreased by 25%. Furthermore, after the phase two intervention, the rate decreased by 65%. This is the first study in Saudi Arabia to describe the outcome of an intervention program intended to reduce the use of unsafe abbreviations.

Intervention programs may fail if they are not focused on specific outcomes that will change the behavior of a physician.

<table>
<thead>
<tr>
<th>Unsafe abbreviation used in pharmacy medication order</th>
<th>Pre-intervention period ($N = 1980^*$)</th>
<th>Three months post-intervention ($N = 1489$)</th>
<th>Six months post-intervention ($N = 710$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>“U” for “unit”</td>
<td>333 (17)</td>
<td>143 (10)</td>
<td>61 (9)</td>
</tr>
<tr>
<td>“IU” for “international unit”</td>
<td>91 (5)</td>
<td>103 (7)</td>
<td>44 (6)</td>
</tr>
<tr>
<td>“QOD” for “every other day”</td>
<td>2 (0.1)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Use of trailing zeros after a decimal point</td>
<td>10 (0.5)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>“MS” for Morphine Sulfate or Magnesium Sulfate</td>
<td>106 (5)</td>
<td>79 (5)</td>
<td>0</td>
</tr>
<tr>
<td>“&gt;” for “greater than”</td>
<td>112 (6)</td>
<td>274 (18)</td>
<td>41 (6)</td>
</tr>
<tr>
<td>Use of apothecary units instead of metric units</td>
<td>2 (0.1)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>“@” for “at”</td>
<td>680 (34)</td>
<td>713 (48)</td>
<td>343 (48)</td>
</tr>
<tr>
<td>“CC” for “mL”</td>
<td>992 (50)</td>
<td>757 (51)</td>
<td>475 (67)</td>
</tr>
<tr>
<td>“μg” for “microgram”</td>
<td>84 (4)</td>
<td>34 (2)</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>“DC” for “discontinue” or “discharge”</td>
<td>624 (32)</td>
<td>89 (6)</td>
<td>0</td>
</tr>
</tbody>
</table>

* Data presented as $n$ (%).

<table>
<thead>
<tr>
<th>Number of errors per drug order</th>
<th>Pre-intervention period ($N = 1980$)</th>
<th>Three months post-intervention ($N = 1489$)</th>
<th>Six months post-intervention ($N = 710$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1173 (59)</td>
<td>923 (62)</td>
<td>470 (66)</td>
</tr>
<tr>
<td>2</td>
<td>595 (30)</td>
<td>445 (30)</td>
<td>225 (32)</td>
</tr>
<tr>
<td>3</td>
<td>179 (9)</td>
<td>105 (7)</td>
<td>15 (2)</td>
</tr>
<tr>
<td>4</td>
<td>30 (2)</td>
<td>16 (1)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>5</td>
<td>3 (0.2)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>
For example, an educational intervention intended to reduce prescribing errors in a teaching hospital did not decrease the use of unsafe abbreviations (Garbutt et al., 2008). However, unsafe abbreviations were reduced in another study that employed an intervention similar to ours that was designed specifically to prevent the use of these abbreviations. The latter study was conducted in 2003 in a 340-bed training hospital in the United States. As in our study, abbreviations dropped after three months (by 16%) and after six months (by 62%); additionally, when the program was extended to eight months, the use of unsafe abbreviations decreased by 83% (Abushiaqa et al., 2007). In another study, the use of computerized alerts reduced the use of unsafe medication abbreviations (Myers et al., 2011).

The current study has several limitations that should be considered. We did not qualitatively and quantitatively assess the factors that contribute to the use of unsafe abbreviations. However, this may not be an important issue given that the goal of our study was to assess an intervention intended to reduce the use of abbreviations. Second, we did not examine the outcomes of using these unsafe abbreviations, or more specifically, whether they negatively affected patient care.

The results of the current study have important implications for practice and research. When designing interventions intended to change the behavior of health care providers, researchers should be sure to use several tools. This study also emphasizes the importance of policy and regulations in changing behavior. It will be easier for hospitals to implement policies that prevent the use of abbreviations in medication orders when the hospital in question is preparing for accreditation. In Saudi Arabia, the requirements instituted by the Ministry of Health stipulating that all hospitals must be accredited by the Central Board of Accreditation for Healthcare Institutions will aid in eliminating the practice of writing medication abbreviations.

One advantage of using information technology in health care is that it can prevent medication errors. For example, the use of computerized physician order entry may eliminate the use of abbreviations and consequently prevent errors. One study in the United States reported that using computerized physician order entry reduced the rate of serious medication errors by 55% (Bates et al., 1998).

In conclusion, the implementation of a complex intervention program reduced the use of unsafe abbreviations by 65%. The use of computerized physician order entry will help in eliminating medication errors caused by abbreviation use.

Acknowledgment

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