**Avoiding Confusion With Alphanumeric Characters**

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**Problem:** The English language uses the Latin alphabet with 26 letters and a numeric system with 10 numerals. These alphanumeric symbols (letters and numerals) work well most of the time to communicate information. However, it may become difficult to interpret written or electronic communications because some alphanumeric symbols are similar in appearance. For example, the lowercase letter “el” (l) looks almost exactly like the numeral 1 (one), and the uppercase letter O looks like the numeral 0 (zero). Because many symbols share similar or even identical physical characteristics, differentiating between them often poses a challenge. Examples of commonly confused alphanumeric symbols are presented in Table 1.

**Handwritten Information**

Letters and numerals that are similar in appearance can contribute to errors when handwritten drug names and doses are misread. Cursive writing is most susceptible to illegibility and carries the greatest risk of error, because various symbols often lack distinctiveness. Following are a few examples of alphanumeric symbols that were misinterpreted in handwritten medication orders.

**Figure 1** An order for 2 mg of Amaryl misread as 12 mg.

**Figure 2** An order for sildenafil 25 mg misread as 125 mg.

A lowercase letter “el” looked like the numeral “1.” A nurse misread an order for 2 mg of AMARYL (glimepiride) as 12 mg (Figure 1). The lowercase “l” at the end of the drug name, as well as the lack of sufficient space between the last letter of the drug name and the dose, led the nurse to misread the dose as 12 mg. The pharmacist processed the order correctly as 2 mg, and the error was realized when the nurse questioned why only 2 mg was dispensed. Similar dosing errors have occurred with other drugs with names ending in the letter “el” (l) (Figure 2).

The uppercase letter “l” looked like an uppercase “I.” While reviewing a medication order for a newly admitted patient, a pharmacist read IODINE in the space for allergies. Another pharmacist thought that the allergy medication listed was LODINE (etodolac). The pharmacist contacted the patient’s physician, who identified Lodine as the correct drug. The patient was not harmed, but failure to document the correct medication could have caused serious injury.

**Electronic Information**

Electronic medical records, medication administration records (MARs), and computerized prescriber order entry (CPOE) systems can help minimize many problems with handwritten information. Although the use of these technologies is growing, even typewritten or computer-generated physician orders might not prevent confusion with certain alphanumeric symbols. For example, a clearly typed prescription for 25 mcg of LEVOXYL (levothyroxine) could be misread as 125 mcg if the name appears without continued on page 665 continued on page 665

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**Table 1 Examples of Commonly Confused Letters and Numerals**

| Lower-case letter l (“el”) and upper-case letter I | Upper-case letter E and upper-case letter F |
| Lower-case letter l (“el”) and numeral 1 | Upper-case letter Z and numeral 2 |
| Lower-case letter o and numeral 0 | Upper-case letter O and numeral 0 |
| Lower-case letter g and lower-case letter q | Upper-case letter B and numeral 8 |
| Lower-case letter m and lower-case letter n | Upper-case letter D and numeral 0 |
| Lower-case cursive letter y and lower-case cursive letter z | Upper-case letter S and numeral 5 |
| Lower-case letter c and lower-case letter e | Upper-case letter S and numeral 8 |
| Lower-case cursive letter l and lower-case cursive letter b | Upper-case letter Z and numeral 7 |
| Lower-case cursive letter l and lower-case cursive letter e | Upper-case letter T and numeral 7 |
| Lower-case cursive letter a and lower-case cursive letter o | Numerals 5 and numeral 8 |
| Upper-case letter T and upper-case letter l | Numerals 5 and numeral 3 |
| Upper-case letter D and upper-case letter O | Numerals 7 and numeral 1 |
Medication Errors

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proper spacing as “Levoxyl25 mcg,” especially since both dosage strengths are available for this drug.

Most of us know how easy it is to misidentify a computer-generated lower-case letter l in an e-mail address as the numeral 1 or the letter O as a numeral 0. Information that contains both numerals and letters—including e-mail addresses or medication orders—is particularly easy to misread. Although the context can sometimes clarify which letter or numeral is meant, it can also detract from recognition. For example, the letters Z, I, and O, amid an array of numerals, can easily be mistaken for the numbers 2, 1, and 0. It may also be difficult for word-recognition software to distinguish L from I, Z from 2, and other look-alike symbols from each other.

In research conducted at Bell Labs, some symbols were more vulnerable than others to being misidentified. The letters l (el) and 1, O and 0, Z and 2, and 1 and 7 accounted for more than 50% of the errors.

Safe Practice Recommendations:
Various methods are available to enhance recognition of look-alike alphanumeric symbols.

Using lower-case letters or mixed-case letters. Although some handwritten lower-case letters are difficult to distinguish (see Table 1), they are more easily differentiated than upper-case letters. Mixed-case (e.g., Tall Man) letters are also more easily distinguished compared with all upper-case or all lower-case letters.

Block printing on lightly lined forms. Prescribers are encouraged to use block printing for handwritten orders. They might save time by using cursive writing, but the time saved needs to be weighed against the risk of creating errors and the tremendous waste of staff time when poorly handwritten orders must be interpreted. Horizontal lines on order forms should be lightly shaded to make them visible to prescribers yet still light enough to prevent confusion with symbols—particularly T, 7, and I or E, F, and L—especially when they are handwritten and when faxed orders need to be read.

Differentiating symbols. In Europe it is common to see a zero written with a slash through it (Ø) to differentiate it from the letter O. The numeral 7 can be written with a bar through it to prevent confusion with the numeral 1, and the letter Z with a bar through it also helps prevent confusion with the numeral 2.

Stricter adherence to these principles in the U.S. could improve character recognition, although changes to the computer software would be required to incorporate these slash marks.

Allowing enough space between the drug name and dose. There should be adequate space between the drug name and the dose on handwritten prescriptions; printed prescriptions and order sets; and electronic formats such as computer selection screens, computer-generated medication labels and records, printed forms, and shelf labels.

Ensuring that the drug and dose make sense. When staff members read an order, they must determine whether the dose is within a recommended range and available in the strength prescribed. If not, it may be necessary to consult with the prescriber to clarify the order. It must also be kept in mind that the context in which the order is read might not always be helpful for identifying alphanumeric symbols accurately, although with medication orders, the context may help raise a red flag if the order has been misread.

REFERENCES

The reports described in this column were received through the ISMP Medication Errors Reporting Program (MERP). Errors, close calls, or hazardous conditions may be reported on the ISMP Web site (www.ismp.org) or communicated directly to ISMP by calling 1-800-FAIL-SAFE or via e-mail at ismpinfo@ismp.org.