A STUDY OF THE ACCURACY OF THE INSTYMEDS AUTOMATED PRESCRIPTION DISPENSING SYSTEM

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The objectives of this study were (1) to determine the accuracy of prescriptions dispensed from the InstyMeds Automated Prescription Dispensing device, pursuant to a prescriber-entered electronic order; and (2) to compare the accuracy of InstyMeds products to that of prescriptions dispensed from typical outpatient and community pharmacies involving pharmacist-inspection of filled prescriptions prior to dispensing to a patient.

The undersigned was the principal investigator (PI) for this study. I am experienced in dispensing accuracy studies (see References and my attached curriculum vitae), and I was awarded the APhA Wiederholt Prize for Outstanding Research in 2010 for a study for which I was primary author, entitled “Dispensing errors and counseling quality in 100 pharmacies” (2009). I am a registered pharmacist, and I currently practice in a community pharmacy on a part-time basis in addition to conducting research. I have first-hand experience with assessing the accuracy of prescriptions in typical pharmacy systems.

**Background**

The results of a national study of dispensing accuracy found that 50 community pharmacies in six states had an overall accuracy rate of 98.3% on a sample of 4,481 filled prescriptions. Errors were detected using direct observation and inspection of filled prescriptions to optimize validity of the results. Most of the 77 errors involved the label: 52% were wrong instruction errors and other incorrect label information was contained on 14% of the errors. Wrong drug errors occurred on 8% and wrong strength errors occurred on 10% of the 77 incorrect prescriptions. Five of the 77 errors (6.5%) were judged as potentially harmful to patients (Flynn et al., 2003). Dispensing error rates in prescription filling operations measured using observation over the past 30 years range from 2% to 10% when comparable definitions are used (Flynn et al., 2003).

**The InstyMeds System**

InstyMeds devices are typically located in emergency departments of rural hospitals and contain a limited formulary of urgent care medications. The InstyMeds automated prescription dispensing system workflow starts with a Verified Accredited Wholesale Drug Distributor (VAWD) supplying the bar coded, prepackaged unit of use medications. The bar coded medications are packaged in a bar coded magazine (cartridge) that also tracks lot number, expiration date and pedigree information. The magazine is inserted into the InstyMeds device and catalogued for dispensing to a patient. Following patient treatment by his or her physician, diagnosis, drug review, order entry and patient medication consultation by the treating physician, the patient selects InstyMeds for prescription delivery. A voucher with a code is given to the patient that is accompanied by written counseling information. The patient proceeds to the InstyMeds device (typically in the waiting area of an emergency department or clinic), verifies his or her identity, and enters the code onto the display screen of the device. The voucher and the display screen of the device show the patient...
how many containers they will receive from the device. When selection, patient-specific labeling
and electronic verification of each prescription ordered is completed, the device releases the
product into the bin for removal by the patient. An example of the voucher and drug information
given to the patient is located in Appendix A.

Methods

A cross-sectional descriptive study was completed at 41 randomly selected InstyMeds sites that
agreed to participate in the study. A letter of introduction to the study (Appendix B) was sent by
InstyMeds after development and approval by the PI. Invitation to participate was made by an
InstyMeds client manager familiar with the staff at the sites. Appendix C shows a sample email
that was sent to sites within a week of agreeing to participate, and following entry of prescriptions
into the InstyMeds system at their site by the PI.

A dispensing error was defined as any deviation on the filled prescription from the prescriber’s
electronic order. Errors were defined in the same way as for the National Dispensing Accuracy
study to allow comparison of the results (Flynn et al., 2003). Error categories included wrong
drug, wrong strength, wrong form, wrong label instructions, wrong label information (except
instructions), wrong quantity and deteriorated drugs. Quantities were assessed for bulk packages,
just as in the National Study (oral solids were not double counted to allow comparison to the
National Study). Complete definitions are located in Appendix D.

Data Collection
Procedures

The principal investigator (PI) logged onto the InstyMeds system as a prescriber and
entered 25 prescriptions for 40 sites, and 15 for the 41st site. The InstyMeds sites
were located in 12 different states (CO, FL, IA, ID, IL, KS, MI, MN, MO, ND, WI, WY).
InstyMeds personnel remotely created six test patients for this study at each site. Four
to five prescriptions were entered for each of these six test patients, for a total of 25

FIGURE 1. TOP 20 MEDICATIONS PRESCRIPTION COUNT

<table>
<thead>
<tr>
<th>Medication</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclobenzaprine</td>
<td>50</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>40</td>
</tr>
<tr>
<td>Phenazopyridine</td>
<td>30</td>
</tr>
<tr>
<td>Meclizine</td>
<td>20</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>15</td>
</tr>
<tr>
<td>SMZ/TMP</td>
<td>10</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>5</td>
</tr>
<tr>
<td>Prednisone</td>
<td>4</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>3</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>2</td>
</tr>
<tr>
<td>Prednisone</td>
<td>2</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>2</td>
</tr>
<tr>
<td>Naproxen</td>
<td>2</td>
</tr>
<tr>
<td>Benzonatate</td>
<td>2</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>2</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>2</td>
</tr>
<tr>
<td>Fluconazole</td>
<td>2</td>
</tr>
<tr>
<td>Promethazine</td>
<td>2</td>
</tr>
<tr>
<td>Albuterol</td>
<td>2</td>
</tr>
<tr>
<td>Mupirocin</td>
<td>2</td>
</tr>
</tbody>
</table>
prescriptions per site. Medications prescribed were independently selected by the PI from those on the formulary at each site, excluded controlled substances, and represented a variety of drugs and forms available in each device. At no time was any InstyMed’s employee involved in the PI’s selection of the prescriptions for this study.

The PI communicated the voucher codes directly to the Pharmacy Director or Nurse Manager at each study site. A feature of the InstyMeds technology is that once the prescription information

TABLE 1. MEDICATIONS EVALUATED IN STUDY

<table>
<thead>
<tr>
<th>Drug Filled</th>
<th>Prescription Count</th>
<th>Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclobenzaprine</td>
<td>55</td>
<td>10</td>
</tr>
<tr>
<td>Cephalexin</td>
<td>47</td>
<td>500</td>
</tr>
<tr>
<td>Phenazopyridine</td>
<td>42</td>
<td>200</td>
</tr>
<tr>
<td>Meclizine</td>
<td>39</td>
<td>25</td>
</tr>
<tr>
<td>Methylprednisolone</td>
<td>38</td>
<td>4</td>
</tr>
<tr>
<td>SMZ/TMP</td>
<td>36</td>
<td>500</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>36</td>
<td>250</td>
</tr>
<tr>
<td>Prednisone</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>32</td>
<td>800</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>31</td>
<td>500</td>
</tr>
<tr>
<td>Prednisone</td>
<td>29</td>
<td>20</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>28</td>
<td>250</td>
</tr>
<tr>
<td>Naproxen</td>
<td>28</td>
<td>500</td>
</tr>
<tr>
<td>Benzonatate</td>
<td>24</td>
<td>100</td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>24</td>
<td>600</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>24</td>
<td>500</td>
</tr>
<tr>
<td>Fluconazole</td>
<td>23</td>
<td>150</td>
</tr>
<tr>
<td>Promethazine</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Albuterol</td>
<td>18</td>
<td>0.083</td>
</tr>
<tr>
<td>Mupirocin</td>
<td>18</td>
<td>2</td>
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<tr>
<td>Augmentin</td>
<td>17</td>
<td>875</td>
</tr>
<tr>
<td>Hydroxyzine</td>
<td>17</td>
<td>25</td>
</tr>
<tr>
<td>Antipyrine,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>benzoicaine, glycerin</td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Cetirizine</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>Diphenhydramine</td>
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<td>25</td>
</tr>
<tr>
<td>Omeprazole</td>
<td>16</td>
<td>20</td>
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<tr>
<td>Triamcinolone</td>
<td>16</td>
<td>0.1</td>
</tr>
<tr>
<td>Cortisporin</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Hydroxyzine Pamoate</td>
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<td>25</td>
</tr>
<tr>
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<td>500</td>
</tr>
<tr>
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<td>200</td>
</tr>
<tr>
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<td>11</td>
<td>5</td>
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<tr>
<td>Prochlorperazine</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Indomethacin</td>
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<tr>
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<td>9</td>
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<tr>
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</tr>
<tr>
<td>Ranitidine</td>
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<td>38</td>
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<td>Clindamycin</td>
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<td>7</td>
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<tr>
<td>Clotrimazole</td>
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<td>7</td>
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<td>Mucinex</td>
<td>43</td>
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<tr>
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<tr>
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</tr>
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<td>Acetaminophen</td>
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<td>2</td>
</tr>
<tr>
<td>Acyclovir</td>
<td>59</td>
<td>2</td>
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<tr>
<td>Amoxicillin</td>
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<td>2</td>
</tr>
<tr>
<td>Dexamethasone</td>
<td>62</td>
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<tr>
<td>Diclofenac DR</td>
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<tr>
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<td>Diphenhydramine</td>
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<tr>
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<tr>
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<td>67</td>
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<tr>
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<tr>
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</tr>
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</tr>
<tr>
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<td>78</td>
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</tr>
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<td>1</td>
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<td>1</td>
</tr>
<tr>
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</tr>
<tr>
<td>Ketocanazole</td>
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<td>Ketorolac</td>
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<td>1</td>
</tr>
<tr>
<td>Loperamide</td>
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<td>Meloxicam</td>
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<td>Metformin</td>
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<td>1</td>
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<tr>
<td>Mucinex DM</td>
<td>89</td>
<td>1</td>
</tr>
<tr>
<td>Nystatin and triamcinolone</td>
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</tr>
<tr>
<td>Ofloxacin</td>
<td>91</td>
<td>1</td>
</tr>
<tr>
<td>Penicillin VK</td>
<td>92</td>
<td>1</td>
</tr>
<tr>
<td>Phenazopyridine</td>
<td>93</td>
<td>1</td>
</tr>
<tr>
<td>Prochlorperazine</td>
<td>94</td>
<td>1</td>
</tr>
<tr>
<td>Promethazine and Dextromethorphan</td>
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<td>1</td>
</tr>
<tr>
<td>Proventil</td>
<td>96</td>
<td>1</td>
</tr>
<tr>
<td>Tamsulosin</td>
<td>97</td>
<td>1</td>
</tr>
<tr>
<td>Tobramycin</td>
<td>98</td>
<td>1</td>
</tr>
<tr>
<td>Ventolin HFA inhaler</td>
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<td>1</td>
</tr>
<tr>
<td>Diclofenac DR</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Dicyclomine</td>
<td>101</td>
<td></td>
</tr>
<tr>
<td>Diphenhydramine</td>
<td>102</td>
<td></td>
</tr>
<tr>
<td>Ibuprofen</td>
<td>103</td>
<td></td>
</tr>
<tr>
<td>Ondansetron</td>
<td>104</td>
<td></td>
</tr>
<tr>
<td>Sulfatrim</td>
<td>105</td>
<td></td>
</tr>
</tbody>
</table>
is entered and the voucher codes are electronically assigned, they are unable to be altered. The 1001 medications were dispensed from the InstyMeds device at each site by the Pharmacy Director, Nurse Manager, or their designee. The forty-one InstyMeds sites shipped the filled prescriptions directly to the PI as verified by viewing the tracking information for each package. Each dispensed container was evaluated for evidence of tampering – for example, oral solids were packaged in sealed containers. At no time was any InstyMed’s employee involved in the shipping of the prescriptions selected by, and shipped to, the PI. Instead, the shipping of the prescriptions was performed by independent medical staff (e.g., Pharmacy Directors, Nurse Managers, etc.) in the medical facility where the InstyMeds device was located.

Prescriptions were inspected by the PI by opening each container, viewing and entering the tablet or capsule ID code into LexiComp Drug ID program or Drugs.com Pill Identifier app for the iPad2 and determining if the product and strength in the dispensed container matched what the ID code represented. Pre-packaged items were evaluated by comparing the manufacturer’s label information to the electronic order. The label information on the dispensed container was then compared to the order entered into the InstyMeds system that matched the patient number and voucher code for the item. Any deviations between the label and the electronic order were considered an error. Data for each prescription was entered into an Access database to facilitate analysis.

The sample size goal of 1,000 was used because this would represent samples of 25 prescriptions from approximately half of all InstyMeds sites at the time of the study. This is the first descriptive study of the accuracy of the InstyMeds device and a sample of 1,000 prescriptions was estimated to provide sufficient evidence to compare to the National Study results.

**Results**

One thousand and one prescriptions were entered and dispensed by InstyMeds devices at 41 locations in 12 states. Ninety-nine different medication products were dispensed (Table 1). Figure 1 displays the frequency that the top 20 medications were used in dispensed prescriptions for the study, demonstrating the common use of the InstyMeds system in emergent care settings. Table 2 displays the variety of medication forms evaluated in the study.

<table>
<thead>
<tr>
<th>Form</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blister pak</td>
<td>113</td>
<td>11.3%</td>
</tr>
<tr>
<td>Inhalant</td>
<td>25</td>
<td>2.5%</td>
</tr>
<tr>
<td>Nasal</td>
<td>1</td>
<td>0.1%</td>
</tr>
<tr>
<td>Ophthalmic</td>
<td>4</td>
<td>0.4%</td>
</tr>
<tr>
<td>Oral liquid</td>
<td>13</td>
<td>1.3%</td>
</tr>
<tr>
<td>Oral solid</td>
<td>744</td>
<td>74.3%</td>
</tr>
<tr>
<td>Otic</td>
<td>32</td>
<td>3.2%</td>
</tr>
<tr>
<td>Powder</td>
<td>6</td>
<td>0.6%</td>
</tr>
<tr>
<td>Pre-pack oral solid</td>
<td>7</td>
<td>0.7%</td>
</tr>
<tr>
<td>Topical</td>
<td>56</td>
<td>5.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1001</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

**TABLE 2. MEDICATION FORMS EVALUATED**
No dispensing errors of any type were detected. The InstyMeds devices exhibited an accuracy rate of 100%.

**Discussion**

The national study measured a 98.3% accuracy rate when traditional prescription filling systems involving a pharmacist final verification. The pharmacist performs many other tasks while verifying prescriptions that are well-suited to human expertise and abilities (e.g., drug utilization review), but 100% accurate prescription inspection is still being pursued.

The prescriber order entry system used with the InstyMeds devices may explain the difference in accuracy of the prescription labels compared to the National Study. Wrong label instructions and other label information were the largest error categories in the National Study, but no errors of these types were detected on the InstyMeds products. The InstyMeds prescriber order entry system does not require any additional editing of the order entered or transcription, as many pharmacy systems do.

**Conclusion**

An accuracy rate of 100% of dispensed prescriptions was achieved by the InstyMeds system on 1,001 dispensed prescriptions. Prescription filling systems that include human inspection have achieved an accuracy rate of 98.3%. The difference of 1.7% in accuracy means that on 300 million prescriptions dispensed in the United States each year, over 5 million prescriptions are filled in error by human systems. In contrast, this study revealed no such errors associated with InstyMeds devices.

Elizabeth Flynn, PhD
APPENDIX A. InstyMeds Voucher and Drug Information Example

InstyMeds Order
Madison Memorial Hospital
450 E. Main St.
Rexburg, ID 83440
Phone: (208) 359-8900

Test Pt 1 TEST

InstyMeds Code: 1856022
The packages contained within InstyMeds machines comply with federal and state packaging laws. Please note that any packages that have been approved to be in a non-child resistant package yield a "keep out of reach of children" caution for your added protection.

Attention Pharmacies: This is not a valid prescription. Please call 952-653-2568 with any questions.

Order: 2268528 Prescribed by: Test Prescriber MD

Rx: 3162047 Refills: 0
Phenergan (generic form) Tablet 25 mg (#15)
Take one or two tablets by mouth every six to eight hours as needed for nausea and vomiting.

*** This prescription for Phenergan (generic form) will have 1 container. ***

Rx: 3162046 Refills: 0
Albuterol Solution 0.083% premixed vial for neb. (#25)
Mix 1 vial(s) and Nebulize every 4-6 hours as needed for wheezing

*** This prescription for Albuterol will have 1 container. ***

Rx: 3162045 Refills: 0
Bactroban (generic form) Ointment 2% (22gm = 1 tube) (#22)
Apply to affected area three times daily

*** This prescription for Bactroban (generic form) will have 1 container. ***

Rx: 3162044 Refills: 0
Amoxicillin Chew Tab 250 mg (#30)
Chew 1 tablet orally three times daily for 10 days

*** This prescription for Amoxicillin will have 1 container. ***

Rx: 3162043 Refills: 0
SSD Cream 1% (#25)
Apply to affected area(s) twice daily

*** This prescription for SSD will have 1 container. ***

Your order will have 5 container(s).
Patient Drug Education

Test Pt 1 TEST
Order: 2268528 By: Test Prescriber MD
Rx: 3162047 Refills: 0
Phenergan (generic form) Tablet 25 mg (#15)
Take one or two tablets by mouth every six to eight hours as needed for nausea and vomiting.

Reed this medicine information sheet carefully each time you get this medicine filled. This medicine information sheet has been written specifically for male patients.

Promethazine Tablets
Pronunciation:
- pro-METH-a-zeen
Brand Name:
- Phenergan
Product Dispensed:
- Phenergan (generic form) Tablet 25 mg (#15)

This medicine is used for:
Relieving allergy symptoms, including hives or runny nose. It is used to prevent and control nausea and vomiting during and after surgery. It is also used to help produce light sleep; prevent and treat motion sickness; or treat pain after surgery, in combination with other medicines. It may also be used for other conditions as determined by your doctor.

This medicine is a phenothiazine antihistamine. It works by blocking the sites where histamine acts.

Do NOT use this medicine if:
- you are allergic to any ingredient in this medicine
- you have severe central nervous system depression or are in a coma
- you are also taking astemizole, cisapride, terfenadine, or tramatol

Contact your doctor or health care provider right away if any of these apply to you.

Before using this medicine:
Some medical conditions may interact with this medicine. Tell your doctor or pharmacist if you have any medical conditions, especially if any of the following apply to you:
- if you are taking any prescription or nonprescription medicine, herbal preparation, or dietary supplement
- if you have allergies to medicines, foods, or other substances
- if you have nervous system problems, bone marrow depression, heart problems, a blood disease, glaucoma, increased eye pressure, low blood pressure, liver problems, prostatic problems, Parkinson disease, seizures, or Rayna syndrome
- if you regularly consume large amounts of alcohol

Some MEDICINES MAY INTERACT with this medicine. Tell your health care provider if you are taking any other medicines, especially any of the following:
- Charcoal or lithium because they may decrease this medicine's effectiveness
- Angiotensin-converting enzyme (ACE) inhibitors (eg, enalapril), astemizole, cisapride, general anesthetics (eg, thiopental), methyldopa, terfenadine, or tramadol because side effects, such as low blood pressure and seizures, may occur
- ACE inhibitors (eg, enalapril), haloperidol, lithium, metoprolol, metoclopramide, monoamine oxidase inhibitors (MAOIs) (eg, phenelzine), naltrexone, polypeptide antibiotics (eg, actinomycin), or trazodone because the risk of their side effects may be increased by this medicine
- Bromocriptine, epinephrine, levodopa, or pergolide because their effectiveness may be decreased by this medicine

This may not be a complete list of all interactions that may occur. Ask your health care provider or pharmacist this medicine may interact with other medicines that you take. Check with your health care provider before you start, stop, or change the dose of any medicine.

How to use this medicine:
Use this medicine as directed by your doctor. Check the label on the medicine for exact dosing instructions.
- If you are using this medicine for motion sickness, take a dose at least 30 to 60 minutes before you begin traveling.
- If you miss a dose of this medicine and you are using it regularly, take it as soon as possible. If it is almost time for your next dose, skip the missed dose and go back to your regular dosing schedule. Do not take 2 doses at once.

Test Pt 1 TEST Phenergan (generic form) Tablet 25 mg (#15)
Patient Drug Education Continued

Ask your health care provider any questions you may have about how to use this medicine.

Important safety information about this medicine:

- This medicine may cause drowsiness or dizziness. These effects may be worse if you take it with alcohol or certain medicines. Use this medicine with caution. Do not drive or perform other possibly unsafe tasks until you know how you react to it.
- Do not drink alcohol or use medicines that may cause drowsiness (e.g., sleep aids, muscle relaxers) while you are using this medicine; it may add to their effects. Ask your pharmacist if you have questions about which medicines may cause drowsiness.
- Neuroleptic malignant syndrome (NMS) is a possibly fatal syndrome that can be caused by this medicine. Symptoms may include fever; stiff muscles; confusion; abnormal thinking; fast or irregular heartbeat; and sweating. Contact your doctor at once if you have any of these symptoms.
- This medicine may cause you to become sunburned more easily. Avoid the sun, sunlamps, or tanning booths until you know how you react to this medicine. Use a sunscreen or wear protective clothing if you must be outside for more than a short time.
- Use this medicine with extreme caution in the ELDERLY: they may be more sensitive to its effects.
- This medicine should not be used in CHILDREN younger than 2 years old. Serious, and sometimes fatal, side effects (difficult or slowed breathing, drowsiness leading to coma) have occurred when this medicine has been used in children in this age group.
- This medicine should be used with extreme caution in CHILDREN 2 years old or older. The lowest effective dose should be used in children 2 years old or older.

Possible side effects of this medicine:

All medicines may cause side effects, but many people have no, or minor, side effects.

- Check with your doctor if any of these most COMMON side effects persist or become bothersome:
  - Blurred vision; dizziness; drowsiness; dry mouth; nausea; vomiting.

Seek medical attention right away if any of these SEVERE side effects occur:

- Severe allergic reactions (rash; hives; itching, difficulty breathing; tightness in the chest; swelling of the mouth, face, lips, or tongue); confusion; excessive sweating; fainting; fever; chills, or sore throat; hallucinations; mental or mood changes (e.g., agitation, delirium, exaggerated sense of well-being, excitability, hyperactivity, nervousness); seizures; severe or persistent dizziness; shortness of breath or trouble breathing; slow or fast heartbeat; tremor; trouble sleeping; uncontrolled muscle movements; unusual bruising or bleeding; yellowing of skin or eyes.

This is not a complete list of all side effects that may occur. If you have questions about side effects, contact your health care provider. Call your doctor for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088. You may also report side effects at http://www.fda.gov/medwatch.

If OVERDOSE is suspected:

Contact 1-800-222-1222 (the American Association of Poison Control Centers), your local poison control center (http://www.aapcc.org), or emergency room immediately. Symptoms may include convulsions; dry mouth; flushing; hallucinations; loss of consciousness; nightmares; seizures; shortness of breath; trouble breathing; unusual drowsiness or restlessness.

Proper storage of this medicine:

Store this medicine at room temperature, between 68 to 77 degrees F (20 to 25 degrees C). Store away from heat, moisture, and light. Do not store in the bathroom. Keep tightly closed. Keep this medicine out of the reach of children and away from pets.

General information:

- If you have any questions about this medicine, please talk with your doctor, pharmacist, or other health care provider.
- This medicine is to be used only by the patient for whom it is prescribed. Do not share it with other people.
- If your symptoms do not improve or if they become worse, check with your doctor.
- Check with your pharmacist about how to dispose of unused medicine.

This information should not be used to decide whether or not to take this medicine or any other medicine. Only your health care provider has the knowledge and training to decide which medicines are right for you. This information does not endorse any medicine as safe, effective, or approved for treating any patient or health condition. This is only a brief summary of general information about this medicine. It does NOT include all information about the possible uses, directions, warnings, precautions, interactions, adverse effects, or risks that may apply to this medicine. This information is not specific medical advice and does not replace information you receive from your health care provider. You must talk with your healthcare provider for complete information about the risks and benefits of using this medicine.

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Database Edition 13.2.1.002
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Questions:

Test Pt 1 TEST Phenergan (generic form) Tablet 25 mg (#15)
APPENDIX B. Invitation to Participate Letter to Sites from InstyMeds

Dear Valued InstyMeds Partner,

For over ten years, InstyMeds has been helping our InstyMeds partners provide medications to sick patients at the point of care, helping patients get better quicker! In fact, we are closing in on 2 million safe and accurate dispenses to date.

We are very proud of these numbers and now it is time to tell the world! We have commissioned a nationally renowned pharmacy safety expert, Dr. Elizabeth Flynn, to independently validate and document the accuracy, safety, and security of the InstyMeds system.

Over the next couple of weeks, approximately 50 InstyMeds clients will be randomly selected to participate in Dr. Flynn’s assessment. If selected, you will receive a phone call from an InstyMeds executive inviting you to participate in the study.

What is involved?

1. We will email or fax you a list of up to 10 voucher codes to be entered into the InstyMeds device at your location.
   - The vouchers will be prescribed for a test patient.
   - Less than an hour of staff time will be needed – anyone on your staff can enter these voucher codes and package the drugs dispensed.
   - You will not be charged for these medications or any associated dispensing fees.
   - Your supply of any one medication will not be depleted – you will receive replacement inventory as needed to replenish the medications dispensed for this study.
   - No controlled substances will be dispensed as a part of this study.

2. You will receive a labeled US Postal Service Mailing Box and tape. Simply place the test samples and paperwork in the mailing box, secure with tape, and mail it directly to Dr. Flynn.

3. As a token of our appreciation for your participation in the study, we will send you a VISA gift card, to use as you wish - perhaps for a staff luncheon.

We thank you in advance for considering this opportunity to demonstrate the accuracy and reliability of the InstyMeds system.

Thank you for your support and use of InstyMeds. We look forward to serving you and your patients in our second decade of service!
APPENDIX C. Email of Instructions Sent to Sites

Dear Mr./Mrs. ________________,

Thank you for participating in the independent study of the InstyMeds device!

At your convenience in the next week, please enter the following voucher codes in the InstyMeds device and place all of the containers dispensed in the shipping containers provided by InstyMeds:

- 679 6131 - 4 containers
- 142 6871 - 4 containers
- 319 9548 - 4 containers
- 626 9939 - 4 containers
- 194 4564 - 4 containers
- 485 6369 - 5 containers

Use January 1 as each patient’s date of birth. You should see a zero co-pay – no charge to anyone.

I inserted a space in each code to make it easier to read and enter – you do not have to enter a space.

If you have any questions or problems you are welcome to call or text me at 575.317.3108 – or email me and Julie Geason at InstyMeds.

Kind regards,

Betsy Flynn
APPENDIX D. Dispensing Error Category Definitions (Buchanan et al., 1991)

1. **Wrong drug**: A medication that is different from what the prescriber wrote on the prescription or, for refill prescriptions, what is printed on the prescription label.

2. **Wrong strength**: A dosage unit containing a different amount of medication than the prescriber specified is dispensed without an adjustment to the dosing instructions to the patient.

3. **Wrong dosage form (correct drug)**: The form of the medication used to fill the prescription is different from what the prescriber wrote on the prescription. Examples of this type of error include filling a prescription with an enteric coated tablet when it was not ordered as such, and using a sustained release product when it was not ordered.

4. **Wrong quantity** (in the national community pharmacy study, quantity dispensed was excluded for oral solids due to the difficulty in accurately collecting this data in a timely and unobtrusive manner unless there was a difference that could be determined without counting on a tray). Quantity was determined in the current study in the same way as for the national study where pre-packaged items were evaluated for quantity. The quantity for bulk packages or oral solids were not double counted so this study’s results would be comparable to the national study. Liquid volumes and the weights of topical agents were assessed. If quantity or volume of liquid could not be determined, the prescription was classified as “no error”, if there were not errors in any other categories.

5. **Wrong prescription label information** (excluding instructions) was defined to include one or more of the following deviations from any one of the federal or state requirements for label contents, whichever was more strict (Fink, 1985):

   - Name and address of device (pharmacy).
   - Serial number of prescription.
   - Date of prescription or date of filling.
   - Name of prescriber.
   - Name of patient, if stated in the prescription.
   - Drug name
   - Drug strength (if more than one strength was available)
   - Quantity dispensed
   - Expiration date
   - Manufacturer or distributor (principal labeler)
6. *Wrong label instructions:* The directions on the prescription label deviated in one or more ways from what was prescribed, except for changes made based on good pharmaceutical practice. (Note that auxiliary label information included on the package by the pharmacist that was not required by the physician was not evaluated in this study.) For example, if “for 14 days” was added at the end of the directions for an antibiotic that should be taken for a complete course of therapy, an error was not counted. However, if the physician wrote “for 14 days” on the prescription and this was omitted from the label instructions, a wrong label instruction error was counted.

7. *Deteriorated drug:* A medication that has exceeded its expiration date is used to fill a prescription, or a medication that is stored in a location that is not in accordance with the manufacturer’s recommendations (for example, outside a refrigerator).
REFERENCES


ELIZABETH ALLAN FLYNN, PHD, RPH
(575) 746-8645  betsy_flynn@hotmail.com

Dr. Flynn is a Clinical Affiliate Associate Professor at the University of Florida, teaching an online class in the distance education M.S. program on Patient Safety Program Evaluation. She is a consultant and part-time community pharmacist. Dr. Flynn telecommuted from her home in New Mexico to her Associate Research Professor position at Auburn University for 13 years. Her expertise is in the application of ergonomics to prevent medication errors and evaluation of technology for effects on medication errors and efficiency. Dr. Flynn has been a co-investigator on over $5 million of research, and has conducted studies in over 250 sites in the U.S., France, the United Kingdom, and Italy. She has published or presented more than 125 papers.

Dr. Flynn was a member of the Institute of Medicine’s Committee on Identifying and Preventing Medication Errors (2005-2006) and the United States Pharmacopeia Safe Medication Use Expert Committee (2005-2010).

1. EDUCATION


2. HONORS AND AWARDS

6. Outstanding Doctoral Graduate Student: Awarded by the Graduate Council Honors Committee, Auburn University, May 18, 1994.
7. Student of the Year, Graduate School: Student Government Association, Auburn University, February 21, 1994.

3. SCHOLARLY CONTRIBUTIONS

A. TEACHING EXPERIENCE

University of Florida (2008 to present)
Affiliate Clinical Associate Professor, Patient Safety Program Evaluation, Master of Science in Pharmacy, Major in Risk Management and Patient Safety. Distance Education program.

Auburn University
Graduate Teaching Assistant in these courses:
Drug Literature Analysis, Institutional Pharmacy I, Drugs and Your Health, Introduction to Medication Information Systems, History and Orientation

University of North Carolina (1983-1985)
Teaching Assistant: Drugs, the Pharmacist, and the Health Care System, Ambulatory Care Pharmacy Practice

Teaching: Graduate students whose work has been completed.
Ranjani Varadarajan, committee member, Master of Science
Achilles Hamilothoris, committee member, Master of Science
Ranjani Varadarajan, committee member, Doctor of Philosophy
Qian Ding, committee member, Doctor of Philosophy

4. RESEARCH AND CREATIVE WORK

BOOKS AND BOOK CHAPTERS


ARTICLE-LENGTH PUBLICATIONS

REFEREED JOURNALS


15. Felkey BG, Flynn EA (40%), Barker KN, Carper JL. Automation and information technology: Satisfying pharmacy’s needs while complying with state board regulations. NABP and US Pharm. 1999.


22. Barker KN, Allan EL (50%). Research on drug-use-system errors. Proceedings,


OTHER PUBLICATIONS

5. Allan EL (100%). A pharmacy manager's guide to successful facility design. *Pharm Times.* 1989;55(May):3HPT-5HPT.

PAPERS, POSTERS, OR LECTURES, REFEREED OR INVITED


PAPERS, POSTERS, OR LECTURES, REFEREED OR INVITED

Contributed.


PAPERS, POSTERS, OR LECTURES, REFEREED OR INVITED


48. Barker KN, Flynn EA. Strategy for re-engineering pharmacy via automation. ASHP
PAPERS, POSTERS, OR LECTURES, REFEREED OR INVITED


62. Allan EL, Barker KN, Gibson JT et al. Analysis of medication dispensing errors in an ambulatory pharmacy as detected by observation. Management Case Study. ASHP
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Midyear Clinical Meeting, Miami, FL: 1994 Dec 8.


PAPERS, POSTERS, OR LECTURES, REFEREED OR INVITED


PATENTS AND COPYRIGHTS

# GRANTS AND CONTRACTS

<table>
<thead>
<tr>
<th>Title/Funding Source</th>
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<tr>
<td>1. AU MEDS observer certification workshops: St. Jude Children’s Research Hospital, Memphis, TN and Flagler Hospital, St. Augustine, FL.</td>
<td>Instructor</td>
<td>2008</td>
<td>(see MedAccuracy contract)</td>
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<td>2. Dispensing Errors and Counseling Quality in 100 Pharmacies: A Followup Study (ABC News 20/20)</td>
<td>Co-PI</td>
<td>2007</td>
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<td>3. AU MEDS observer certification workshop - renewal (Lancaster General Hospital)</td>
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<td>4. AU MEDS observer certification workshop - renewal (DCH Health System)</td>
<td>PI</td>
<td>2007</td>
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<td>5. Effect of premixed IV drugs on medication errors and costs (Baxter Healthcare)</td>
<td>Co-PI</td>
<td>2006</td>
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<td>6. Pharmacy Design for a Home Infusion Pharmacy (VitalCare)</td>
<td>Co-PI</td>
<td>2006</td>
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<td>7. Auburn University Medication Error Detection System (AU MEDS) observer certification workshop - renewal (East Alabama Medical Center)</td>
<td>Co-PI</td>
<td>2006</td>
<td>$30,000</td>
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<td>8. Evaluating technology for Improving Dosage Calculations (InformMed)</td>
<td>Co-PI</td>
<td>2006</td>
<td>$110,808</td>
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<td>9. AU MEDS observer certification workshop - renewal (Lancaster General Hospital)</td>
<td>Co-PI</td>
<td>2006</td>
<td>$30,000</td>
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<td>10. Training and Technical Support for AU MEDS (MedAccuracy LLC)</td>
<td>Co-PI</td>
<td>2006</td>
<td>$126,000</td>
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<td>11. AU MEDS renewal (DCH Health System)</td>
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<td>12. Development and Evaluation of Sterile Preparations Fixtures for Hospital Pharmacy (MMI of Mississippi)</td>
<td>Co-PI</td>
<td>2005</td>
<td>$208,368</td>
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<td>13. Study to Evaluate Alabama Mental Health Pharmacy System (Alabama Department of Mental Health &amp; Mental Retardation)</td>
<td>Co-investigator</td>
<td>2005</td>
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<td>14. AU Meds renewal (Lancaster General Hospital)</td>
<td>Co-PI</td>
<td>2005</td>
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<td>15. AU Meds Observer Training (Johns Hopkins Hospital)</td>
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<td>16. AU Meds renewal (Northeast Georgia Medical Center)</td>
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<td>17. AU Meds renewal (HealthEast System, MN)</td>
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<td>19. AU Meds renewal (Lancaster General Hospital)</td>
<td>Co-PI</td>
<td>2004</td>
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<td>21. Study of PharmaCorr Dispensing Systems (Bryan Cave)</td>
<td>Co-PI</td>
<td>2004</td>
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<td>22. AU Meds Medication Observer Training (Lancaster General Hospital)</td>
<td>Co-PI</td>
<td>2003</td>
<td>$30,000</td>
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<td>23. AU Meds Medication Observer Training (DCH, Tuscaloosa)</td>
<td>Co-PI</td>
<td>2003</td>
<td>$30,000</td>
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<td>24. AU Meds renewal (HealthEast)</td>
<td>Co-PI</td>
<td>2002</td>
<td>$20,000</td>
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<td>25. AU Meds Medication Observer Training (HealthEast)</td>
<td>Co-PI</td>
<td>2001</td>
<td>$20,000</td>
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<td>27. Evaluation of NextRx System (NextRx)</td>
<td>Co-PI</td>
<td>2000</td>
<td>$204,964</td>
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<td>28. Development and Evaluation of NextRx System (NextRx)</td>
<td>Co-PI</td>
<td>1999</td>
<td>$170,000</td>
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<td>29. Cost of Administration Study of Voriconazole in five hospitals in Italy, France and the United Kingdom (Pfizer Limited)</td>
<td>Co-PI</td>
<td>1999-2005</td>
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<td>30. Study to Develop an Electronic Medication Management Information and Telepharmacy Center (MMI of Mississippi)</td>
<td>Co-PI</td>
<td>1998</td>
<td>$120,000</td>
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<td>31. Study to Identify the Most Effective and Efficient Medication Error Detection Method in Hospitals and Skilled Nursing Facilities. (Alabama Quality Assurance Foundation, Health Care Financing Administration)</td>
<td>Co-PI</td>
<td>1998</td>
<td>$469,008</td>
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<td>32. A System to Identify Causes of Medication Errors (Health System Requested Anonymity)</td>
<td>Co-PI</td>
<td>1997</td>
<td>$70,000</td>
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<td>33. Reengineering a Large Chain-Store Pharmacy</td>
<td>Co-Inv.</td>
<td>1996</td>
<td>$382,472</td>
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<td>36. A Medication Error Monitoring System for Two Hospitals (Health System Requested Anonymity)</td>
<td>Co-PI</td>
<td>1995</td>
<td>$64,163</td>
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<td>37. A Study of IV Compounding Accuracy in Hospitals (Central Admixture Pharmacy Service)</td>
<td>PI</td>
<td>1995</td>
<td>$58,036</td>
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<td>38. Design of a Sterile Compounding Center for the Future (Central Admixture Pharmacy Service)</td>
<td>PI</td>
<td>1995</td>
<td>$101,262</td>
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<td>40. Study to Develop the Sterile Compounding Center of the Future and Evaluation of a Frozen Intravenous Product Thawing Unit (MMI of MS)</td>
<td>Co-PI</td>
<td>1992</td>
<td>$35,808</td>
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<td>41. The Effects of the MEDSTATION™ System on Nursing and Pharmacy Time: A Demonstration Study with Evaluation at Baylor University Medical Center, Dallas, TX (Pyxis Corporation)</td>
<td>Res. Assoc.</td>
<td>1989</td>
<td>$75,427</td>
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</tbody>
</table>
3. UNIVERSITY OUTREACH

1. Instructional activities.
   1. AU Meds Observer Training Workshop, three days, developer and presenter, target audience is hospital nurses and pharmacists, lecture, interactive video, practical experience, presented more than 25 times, with over 100 observers trained.

2. Technical assistance.
   2. Functional Program for Hospital Pharmacy designs: These projects involved the development of written specifications for new hospital pharmacy facilities based on on-site observations and assessments of existing physical space. A Functional Program describes the following details for hospital pharmacies: Functions, Work Flows, Work Areas, Workload, Equipment, Storage Requirements, Special Work Area Requirements, Arrangement of Work Areas, Space Requirements, Diagrammatic Plans, and Ergonomic Requirements. The details provided by the program enable an architect to spend more time developing functional and efficient work spaces that incorporate the latest research results on the effects of the work environment and facilities on medication errors and performance. Functional Programs were developed for the following clients:
      a. William Beaumont Hospital Department of Pharmacy, Detroit, Michigan
      b. Cleveland Clinic Foundation Department of Pharmacy, Cleveland, Ohio
      c. St. Mary’s Hospital Department of Pharmacy, Huntington, West Virginia
      d. Beth Israel Deaconess Medical Center, Boston, Massachusetts
      e. Crawford Long Hospital of Emory University, Atlanta, Georgia
      f. Kaiser Permanente, Mid-Atlantic States Region
g. Maine Medical Center, Portland, Maine
h. University Hospital, Augusta, Georgia
i. Baptist Hospital of Miami, Florida
j. Queen’s Medical Center, Honolulu, Hawaii
k. Long Beach Memorial Medical Center, California

3. Consultation on research projects and medication observer training for data collection: Technical assistance was provided on the following projects:
   c. Decreasing Vulnerability to Medication Errors: A Measurement Study, University of Colorado Health Sciences Center (UCHSC) School of Nursing, Denver, Colorado, Consultant - observation method to detect errors, July, 2001 to present. Funded by the Agency for HealthCare Quality Research.
   d. Comparison of dedicated medication nurses to traditional nurse medication procedures, Cedars-Sinai Medical Center, Los Angeles, California and The Ohio State University, Columbus, Ohio. Funded by the National Patient Safety Foundation.
   e. Assessment of Pharmacy Compounding Errors and Nurse Administration Errors in Three Clinics, Dana Farber Cancer Institute, Boston, Massachusetts.
   f. Effect of information technology on medication error rates in an emergency room. Proposal to the Agency for HealthCare Quality Research by the University of Utah School of Nursing, not funded. Consultant - observation method to detect errors.
   g. Staff Nurse Work Hours, Errors and Magnet Status, Proposal to the Agency for HealthCare Quality Research by the University of Pennsylvania School of Nursing, not funded. Consultant - observation method to detect errors.
   h. Effect of bar code medication inspection system implementation on medication errors in hospitals, Proposal to the Agency for HealthCare Quality Research by the Health Research and Educational Trust of the American Hospital Association, not funded, 2004. Consultant on use of the observation method to detect medication errors.

4. System Analysis and Re-engineering of a hospital pharmacy department: Emory University Hospitals, Atlanta, Georgia

5. Research on the frequency of pharmacy dispensing errors in 100 pharmacies for American Broadcasting Company (ABC) “PrimeTime Live” program (see Allan et al. 1995 publication).

6. Consultant on pharmacy dispensing error prevention to Raley's Pharmacy, Sacramento, California and Albertson's Pharmacy, Boise, Idaho.

7. Pharmacy design consultant, University of Cincinnati, Ohio (see Lin et al. publication).

8. Assessment of ergonomic design problems in the pharmacy at Eisenhower Army Medical Center, Augusta, Georgia.
9. Consultant on evaluation of an automated medication dispensing cabinet, Veteran's Administration Medical Center, Little Rock, Arkansas.

D. PROFESSIONAL SERVICE

2. Reviewer, Quality Improvement course content, PQA, Terri Warholak, 2008.
9. Member of the META Network (Medication Error and Technologies Analysis), sponsored by the United Kingdom's Medical Research Council (MRC), the Department of Health, the Economic and Social Research Council (ESRC), the Engineering and Physical Sciences Research Council (EPSRC), and the University of London. January 2004 – September, 2005.
11. Reviewer, Quality and Safety in Health Care.
13. Reviewer, Pharmacotherapy.
18. Reviewer, American Journal of Health-System Pharmacy.
21. Chair, Dishonorable Conduct Committee, New Mexico Board of Pharmacy, 2002-4.

24. Member, Adverse Drug Event Committee, New Mexico Board of Pharmacy, 2001.


30. Member, American Pharmacists Association

31. Member, American Society of Health-System Pharmacists

32. Member, Human Factors and Ergonomics Society

33. Member, American Association of Colleges of Pharmacy

34. Member, Christian Pharmacists Fellowship International

35. Member, New Mexico Pharmacists Association

36. Member, New Mexico Society of Health-System Pharmacists

PRACTICE

1. Community Pharmacist, Kmart Pharmacy, part-time, 2009 to present
2. Hospital Pharmacist, Roswell Regional Hospital, part-time, 2010 – 2013
5. Ambulatory Pharmacy Supervisor, University Hospitals of Cleveland, Ohio, July, 1985 to June, 1986.
6. Staff Pharmacist, Inpatient Pharmacy, Veterans Administration Medical Center, Gainesville, Florida, April, 1983 to June, 1983.