AN EXPLORATORY STUDY OF THE PERCEIVED USE OF WORKAROUNDS

UTILIZED DURING THE PRESCRIPTION PREPARATION

PROCESS OF PHARMACIES IN ALABAMA

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# AN EXPLORATORY STUDY OF THE PERCEIVED USE OF WORKAROUNDS UTILIZED DURING THE PRESCRIPTION PREPARATION PROCESS OF PHARMACIES IN ALABAMA

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A Thesis

Submitted to

the Graduate Faculty of

Auburn University

in Partial Fulfillment of the

Requirements for the

Degree of

Master of Science

Auburn, Alabama

August 10, 2009

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## THESIS ABSTRACT

# AN EXPLORATORY STUDY OF THE PERCEIVED USE OF WORKAROUNDS UTILIZED DURING THE PRESCRIPTION PREPARATION PROCESS OF PHARMACIES IN ALABAMA

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112 Typed Pages

Directed by Bill G. Felkey and Salisa C. Westrick

The use of workarounds has been mentioned in the literature of various healthcare disciplines. However, there has been limited research thoroughly investigating the workaround phenomena and none conducted exclusively in the pharmacy setting. A survey methodology with a response rate of 25.5% was used to determine the workaround use in pharmacies as reported by a random sample of pharmacists (*N* = 99) and pharmacy technicians (*N* = 42) registered with the Alabama Board of Pharmacy.

Analyses were conducted to determine the relationship between workaround use and selected variables (staff characteristics, general pharmacy characteristics, and technology characteristics). A cluster analysis showed that there were identifiable subgroups of respondents that differed in the use of workarounds. The pharmacy technology characteristics had the most impact on the average workaround frequency reported with staff characteristics also being represented in the CHAID trees.

APA style used

Microsoft® Office Excel 2007 used

Microsoft® Office Word 2007 used

SPSS 16.0.1 for Windows used

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

# Chapter 1: INTRODUCTION

The healthcare system in the United States has become a dynamic, multidisciplinary, two trillion dollar industry drawing from not only anatomy, physiology, and pharmacology, but also information technology (NHE Fact Sheet, 2007; Sainfort, Jacko, & Booske, 2002). Alongside the growth in cost of healthcare services we have also seen more advanced technology implemented to help diagnose, treat, and monitor our patient's health status. The push to increase the use of information systems in healthcare owes a lot to a popular belief that the use of technology is essential to providing safer care to patients (Ash, Berg, & Coiera, 2004; McCartney, 2006; Obradovich & Woods,1996; Phillips & Berner, 2004; Vogelsmeier, Halbesleben, & Scott-Cawiezell, 2008). In recent years, technology such as electronic medical records (EMRs), patient and medication bar coding, medication dispensing robots and cabinets, and automated medication infusion devices have begun to receive the adoption and attention that was anticipated in the 1990s.

The health systems' approach to healthcare is also changing. Patient care has evolved from having one family physician per patient over a lifetime to now a host of healthcare providers who may advise on the treatment of a single medical incident. To effectively provide patient care services in today's health care practices, it is important to use integrated documentation to allow for subsequent healthcare providers to build upon one patient's previous therapy decisions (McCartney, 2006). Not only would this shared documentation allow for the opportunity to improve the effectiveness of therapy for a particular disorder, but it could also act as a safety mechanism in that unknown allergy and co-morbid conditions are seen by practitioners whom may have not been afforded the opportunity to collect such information. An example for illustration; an unconscious patient is admitted to the Emergency Department. Despite the inability of the patient to communicate all of his/her health information, the treating practitioner could obtain pertinent information by accessing the patient's comprehensive health record. Later, when the pharmacist is filling a prescription to be picked up by the patient's care giver, specific counseling points can be addressed concerning the new medication and the recently treated incident in addition to the patient's past medical history. But all of this is possible only given a single comprehensive health record that is readily retrievable by all practitioners.

### 1.1. Healthcare Information Technology

The ultimate goal of a single unified patient health record has had some obstacles; and to date this goal has not been truly achieved. Physicians, nurses, pharmacists, and countless other types of providers are now expected to use and master highly complicated and continually updated medical information systems during their daily workflow of caring for patients and dispensing medications (Ash et al., 2004; McCartney, 2006; Vogelsmeier et al., 2008). These information systems vary in their complexity between technology venders and families of software and hardware (Sainfort et al., 2002). The systems can be purchased in enterprise packages which are expected to cover an entire entity such as a network of hospitals from top to bottom with complete integration. Alternatively, the system components can be purchased piecemeal, such as in the best-of-breed concept, in which the components are purchased from various vendors and then incorporated into the workflow with varying degrees of integration.

A common functionality of a hospital's electronic medical record is to detail a patient's medical history for continuity of care throughout an emergency department visit, hospital admission, and subsequent outpatient visit. Occasionally, transferring this information or a subset of the information is possible between practice settings unrelated to the hospital. Some of these electronic charting systems also allow electronic prescribing and transmission of prescriptions to the hospital pharmacy and/or community pharmacies (Vogelsmeier et al., 2008; McCartney, 2006).

Clinical decision support systems have become integrated into most all healthcare information systems in some form in an effort to increase patient safety (Ash et al., 2004). A decision support system can check for interactions between prescribed drugs and herbal medications, over-the-counter medications, disease states, co-morbidities, and laboratory test results. Also, a feature of some advanced decision support products include medication efficacy data, peer reviewed literature and therapy recommendations based upon the patient's laboratory results and symptom presentation (Ash et al., 2004; McCartney, 2006).

The use of medication dispensing robots and cabinets, automated compounders, and electronic medication administration records (eMAR) has also become popular over the past several years. These devices commonly incorporate bar code technology in an effort to ensure the five rights of medication administration which seeks to eliminate wrong patient, wrong drug, wrong drug strength, wrong route, and wrong timing of medications given. However, the literature is mixed on healthcare technology as to its overall effect on medication errors, whether it is positive or negative (Vogelsmeier et al., 2008; Ash et al., 2004; Koppel et al., 2005; McCartney, 2006; Patterson, Rogers, Chapman, & Render, 2006). Some suggest that there is an initial increase in errors which is followed by a phase of a reduction of errors below the original average.

There have been several explanations proposed to explain this phenomenon. The introduction of new technology may also introduce a new category of errors into the system that were not previously an issue (Koppel et al., 2005; McCartney, 2006; Patterson et al., 2006). The technology may have decreased the errors of one category while allowing for the number of errors overall to increase due to a new category of errors or better measurement of previously recorded errors. For example, a hospital implements bar code medication administration (BCMA) for nurses to use at the patient's bedside. Two potential increases to the hospital's overall error rate could occur. The number of late doses given may now be easily tracked and documented with the new system whereas in the past this type of error was more elusive to capture. There is a possibility of a nurse getting in a continuous self perpetuating loop of late doses if the system is configured to require the documentation of a reason for giving a late dose. The time it takes to input a late dose reason may lead to the late dosing of the next medication on the nurse's schedule, theoretically perpetuating this late dosing cycle (Phillips & Berner, 2004).

Another possible cause of the overall increase in errors is the learning curve associated with using a new technological system. Mistakes will be made while users are learning new systems and it is expected that they will become more accurate with experience. Also, claims of the impacts on errors can be misleading by the introduction of other variables (another system or device) in addition to the target technology over the same study period. This introduction of confounding variables makes it difficult to identify the true effect of any technology individually.

To complicate the picture even further, healthcare information systems are used by many people other than the institutional medical practitioners. Hospital administrators, account and finance managers, consulting professionals, technicians, and students are among those granted specialized access (Sainfort et al., 2002). The level of access and functionality is typically based upon the user's level of need. For example, a medical student has no significant need of the technical aspects of the billing and collections department data other than possibly diagnosis codes. The details of who is the primary versus secondary insurer and the tiers involved in co-payment coverage are also of limited value to a medical student. Further, along that same logic, the billing department may only be interested in the diagnosis and treatment codes associated with a practitioner-patient interaction and not necessarily the gross physiologic findings that support the diagnosis.

The previous example of interdepartmental sharing of information highlights the value of the information contained in these systems and why it is important that these data be structured and organized. A complete picture of a patient’s visit should be captured by the system that is used. An efficient means of collecting the pertinent information is expected to be achieved using organizationally defined workflows. Workflows help to ensure the consistency and quality of the data entered into the system. The use of a specified workflow is also intended to yield the most effective and efficient use of the system’s features. When installing a new system or component, often the system’s workflow is not the same workflow already established within an organization’s normal operating procedures (Poelmans, 1999; Sobreperez, Ferneley, & Wilson, 2005; Tucker & Feldman, 2004; Vogelsmeier et al., 2008). This workflow conflict can be the stepping stone for a cascade of problems that users encounter while using the new system or component (Kobayashi, Fussell, Xiao, & Seagull, 2005; Vestal, 2008).

### 1.2. Procedural Workflow

Procedural workflows describe any task related process information that is needed to carry out a project such as who is to perform the specific processes involved, the order in which the processes should occur, the equipment to be used, and any decision junctions that may be involved (Ferneley & Sobreperez, 2006; Poelmans, 1999; Spear & Schmidhofer, 2005; Vogelsmeier et al., 2008). For example, Alabama state law specifies that only a licensed pharmacist or pharmacy intern may reduce a physician’s verbal order (direct communication or voicemail) into a written prescription to be dispensed to a patient. A pharmacy's procedural workflow for taking prescriptions off of the pharmacy's voicemail could be represented verbally and graphically.

Verbal voicemail workflow description:

> At the top of the hour the voicemail will be checked for messages. If a message is present, then a licensed pharmacist or pharmacy intern will review the message. If the message is a verbal order to dispense a medication to a patient then the pharmacist or intern must reduce the order to a legally valid written prescription using the pharmacy's prescription pad. The pharmacist or intern must initial the written prescription to identify the person who received the verbal order. The voicemail message will then be erased unless there is a need to save it.

Graphical voicemail workflow description:

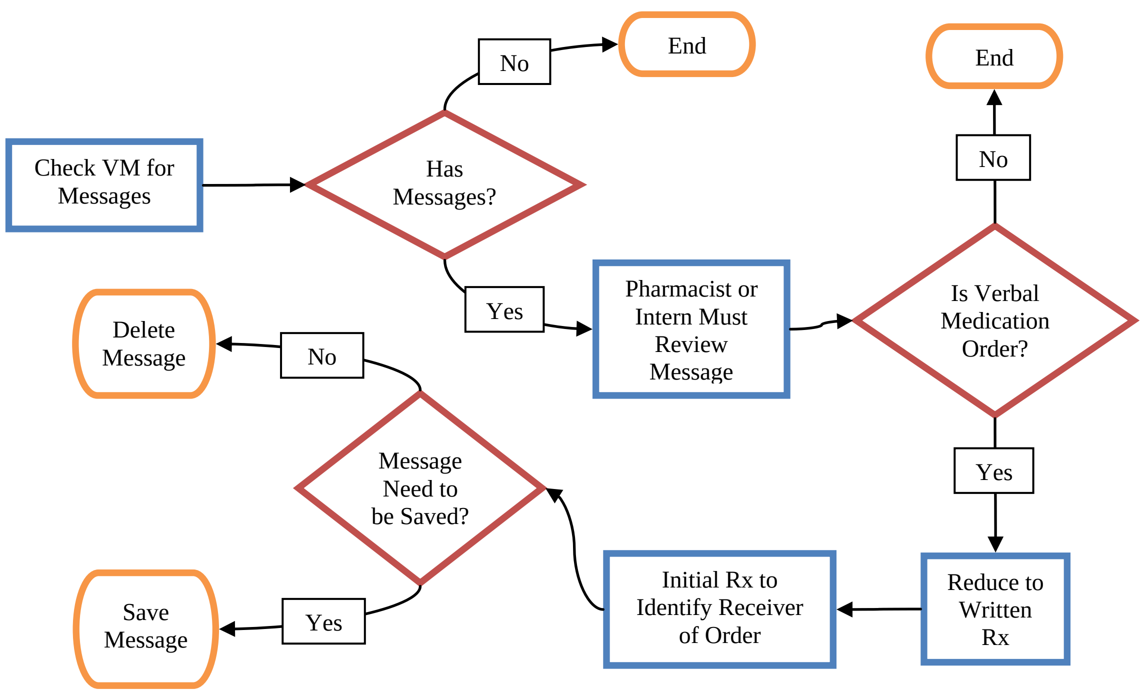



**Figure 1: Graphical Workflow**

Defined procedural workflows may not be used if a system has an ineffective interface that leads to poor human-computer interaction (HCI), which can decrease the quality of the data captured or even facilitate medical errors (Vogelsmeier et al., 2008). In some instances a user's deviation from the procedural workflow is such a routine that they may not realize that it is not the official process (Hayes, 2000). This is best illustrated by the training of new employees an incorrect process used by the veteran staff members which can perpetuate the improper workflow. This ineffective interface and/or trained improper workflow can lead to poor data input which may not capture enough of the information needed for proper initial treatment, follow-up care, or complete service reimbursement. Also a poor user interface can lead, or contribute to users not using the system properly, intentionally or unintentionally (Hayes, 2000; Obradovich & Woods, 1996; Sobreperez et al., 2005).

In addition to ineffective interfaces and improper workflow, other problems occur when the people who make the decisions on which systems are purchased and implemented are not the actual users of the systems. Systems are chosen based upon budget constraints, contractual obligations, or other non-medical rationale in some organizations. The users of these systems can be forced to comply with a workflow that incorporates the use of the system regardless of the effectiveness or usefulness in the user's scope of practice. When the use of these systems is seen as inefficient, ineffective, or cumbersome the users may attempt to bypass a process of the workflow, termed a workaround (Ferneley & Sobreperez, 2006; Hayes, 2000; Obradovich & Woods, 1996; Petrides, McClelland, & Nodine, 2004; Patterson et al., 2006; Poelmans, 1999; Tucker &

Feldman, 2004; Vestal, 2008; Vogelsmeier et al., 2008). This bypass can have ripple effects such as the introduction of erroneous information, safety barrier failures, and misleading administrative information (Kobayashi et al., 2005; Sobreperez et al., 2005; Vestal, 2008). These ripple effects are not always intended by users with the immediate process circumvention which is employed to overcome some undesired obstacle. But, nonetheless these too can be the byproducts of workflow process deviations.

The discussion above describes a short list of the complexities that are now typical in healthcare information systems. Integration of systems is an acknowledged challenge that was not addressed. The introduction of technology into the practitioner's workflow increases the chance for hardware/software failures, user errors, and process omissions. These failures and actions can complicate patient care since treating patients is approached by some practitioners with a "get it done" mentality (Spear & Schmidhofer, 2005; Vestal, 2008). In the scenario of practitioners with a "get it done" mentality who encounter system complexity, inefficiency, or failure they may opt to treat their patients using a workaround without regard to the lack of proper electronic documentation that could result from the use of the workaround (Ferneley & Sobreperez, 2006). This approach coupled with system failures or shortcomings opens the door for novel approaches of beating and/or cheating the information system when it is the system that is seen as the barrier to providing patient care (Vestal, 2008; Vogelsmeier et al., 2008).

## 1.3. Human-Computer Interaction

Human-computer interaction (HCI) concepts can be used to explain health care technology systems. Obradovich and Woods (1996) described HCI as, “much more than a luxury factor or marketing edge; it is fundamental to patient safety and device efficacy.” Claims in the HCI literature that the use of a poorly designed user interface can potentially lead to the introduction of errors into an otherwise stable system helps to illustrate the importance of the contribution of HCI in healthcare (Ash et al., 2004; Obradovich & Woods, 1996). Dynamic interfaces must be developed for these systems in order to accommodate a diverse field of users (Sainfort et al., 2002; Obradovich & Woods, 1996). The interface most acceptable to a clinician’s workflow is vastly different from that of someone in the billing department, yet many users of the system will share the same data repository. For example, data that are generated by a physician in a clinical context may later be used for billing purposes and even later in an educational environment.

It has been proposed by Albers (1998) that when a system’s users are working in ill-structured environments, such as in many healthcare settings, the users’ actions are goal-driven (Sainfort et al., 2002). This is in contrast to the task-driven concept which has been stated as best applying to highly structured environments such as an automotive assembly line. In the clinical environment practitioners are problem solvers and decision makers and thus the goal-driven behavior adequately fits this group of users. Having a goal-driven system user helps to explain the prevalence of the use of workarounds in the healthcare environment.

In this first chapter, I have given an overview of the U.S. health care system, existing information technology, procedural workflow and human-computer interactions. In the next chapter, I summarize existing research related to workarounds which is the focus of this study.

# Chapter 2: LITERATURE REVIEW

Workarounds have been mentioned in the literature of many different disciplines other than healthcare (Casati, 1999; Day, 1996; Gasser, 1986; Hayes, 2000; Kingston, 2001; Koopman & Hoffman, 2003; McInerney & Sobiesiak, 2000; Petrides et al., 2004; Vicente, 2002; McCollin, 1999). They have even been reported in the medical literature, mostly involving nursing and physicians. The most frequently published healthcare technology appears to be that which involves bar code technology. Workarounds have been cited as being actions that can have positive, negative, and neutral effects on the system in which they are utilized (Gasser, 1986; Hayes, 2000; Kobayashi et al., 2005; Koopman & Hoffman, 2003; Martin & Koopman, 2004; Obradovich & Woods, 1996, Patterson, Rogers, & Render, 2004; Patterson et al., 2006; Phillips & Berner, 2004; Poelmans, 1999; Sobreperez et al., 2005; Tucker & Feldman, 2004; Vogelsmeier et al., 2008). However, despite this broad coverage there has been little research thoroughly investigating the workaround phenomena (Kobayashi et al., 2005). This seems to be due to several challenging factors inherent to studying workarounds. In order to achieve valid generalizable results multiple facilities would need to be studied by direct observation since workarounds may not be captured by software alone (Patterson et al., 2006; Phillips & Berner, 2004). In addition to the expense that direct observation studies pose, there is the problem of study participation. As stated by Obradovich and Woods (1996), “finding device deficiencies and exposing error traps is a politically, legally, and financially charged enterprise.” Similarly, study sites may not be willing to participate possibly due to the potential for negative publicity associated with the organization. As of first quarter 2009, there has been no other published research examining the use of workarounds exclusively in a pharmacy setting.

### 2.1. Defining Workarounds

The term workaround has been referred to and/or defined a number of times in the literature. Many of the definitions proposed are similar. The following is a compilation of the various definitions and descriptions used to describe workarounds:

- Clever alternative approaches (Ash et al., 2004).
- Alternative routes to arrive at a goal (Vestal, 2008).
- Intentionally using computing in ways for which it was not designed or avoiding its use and relying on an alternative means of accomplishing work. Workarounds are typically ad hoc strategies to solve immediate and pressing problems. They often conflict with the formal ideology of system use (Gasser, 1986).
- A coping strategy that deviates from the strategies that have been defined in the workflow system. End-users work around the system to save time and/or efforts or to avoid the limitations of the workflow system (Poelmans, 1999).
- “Activities that people undertake when encountering error conditions or exceptional operating conditions”; Martin and Koopman's (2004) summary of the workaround concept by Albers (1998).

- A procedural change to using a computer system intended to compensate for a hardware or component failure (Koopman & Hoffman, 2003).
- Informal temporary practices for handling exceptions to normal workflow (Kobayashi et al., 2005).
- Termed “subversion”, the user modifies the task approach to take advantage of known weaknesses in the tool, overriding the spirit but not the mechanism by which the constraint is implemented (Day, 1996).
- Overriding the automated system to accomplish a task (McCartney, 2006).
- Koopman and Hoffman (2003) reference several different sources which defined workarounds:
    - The Concise Oxford Dictionary: “A method for overcoming a problem or limitation in a program or system.”
    - Wikipedia: “A bypass of a recognized problem in a system.”
    - Whatis.com: “A method, sometimes used temporarily, for achieving a task or goal when the usual or planned method isn’t working”.
- Koopman and Hoffman (2003) also proposed their own definition as being “when a path to a goal is blocked, people use their knowledge to create and execute an alternate path to that goal.”

There has been much speculation as to the potential impact that the use of workarounds can have in the clinical setting (Kobayashi et al., 2005; Obradovich & Woods, 1996; Vogelsmeier et al., 2008). Extreme opinions have been presented by authors and have ranged from their potential to cause medical errors and organizational instability to some claiming that planning for workaround behavior incorporation is necessary to help improve system evolution, robustness, and safety (Kobayashi et al., 2005; Martin & Koopman, 2004; Obradovich & Woods, 1996; Patterson et al., 2004; Patterson et al., 2006). However, there remains little research that quantifies these claims in different information technology.

Kobayashi et al. (2005) looked beyond just the technologies involved and more at the workflow of the workload and its impact at the hospital personnel level. The description of workarounds that were identified typically involved the coordination of events by multiple staff members which led to the proposal of “key features” of workarounds. A person’s role, knowledge of others’ abilities, willingness to help, and the reciprocation of favors played a role in the workarounds they discovered. Also identified was the potential for the cascading effect of workarounds in which one workaround may lead to the need to use more workarounds later as a byproduct of the first. The idea that workarounds be included in the formal workflow is a more tangible version of a similar idea proposed by Hayes (2000). Both papers claim that the acceptance of and planning for workarounds in a system can lead to positive results if done appropriately.

Ferneley and Sobreperez (2006) studied the workaround behavior and its relationship with user resistance models. In their paper, they discussed the earlier literature of resistance behavior and how it ranged from a lack of cooperation to deliberate sabotage. Through an analysis of two case studies they presented an argument for a revised model of resistance behavior that specifically addressed the workaround behavior. Their revised model, a compliance/resistance/workaround model, was represented graphically in a manner similar to a Venn diagram. At the highest level a user was completely compliant with workplace policies and procedures. Below compliance, the resistance behavior was subdivided into either positive resistance or negative resistance. Positive resistance behaviors were workarounds that were used to "support or improve working practices." They discussed negative resistance behaviors as workarounds such as "physical sabotage, deliberate entering of incorrect data, deliberate omission [or modification] of auditable steps [or] data."

The lowest level of their model was subdivided into categories of workarounds. Essential workarounds were those which were required in order to complete the task at hand. The other two categories were behaviors that were not required but were used instead of the workplace policies or procedures. Hindrance workarounds were stated as being the user's response to a process that took too long or was too difficult to complete. This hindrance concept is very similar to Poelmans (1999) concept of viscosity which was described as extra effort caused by the workflow system that does not contribute to the end user's goal. And the last category, harmless workarounds were those in which the tasks were completed outside of the expected manner but were completed without affecting the normal workflow or data accuracy.

The connections drawn from the resistance level to the category of workaround behavior are determined by the behavior impact on the task. Essential workarounds are the result of positive resistance only. However, hindrance and harmless workarounds can be due to either positive or negative resistance. The model is considered to be dynamic in that the behavior has to be taken in context and may be viewed differently by the individual, developer, management, or organization. Interestingly Sobreperez et al. (2005) argued in an earlier paper against a simplistic categorization of workarounds and proposed a very elaborate classification structure and also claimed that “all workarounds result in incorrect data generation.” This is in conflict with the paper authored by Ferneley and Sobreperez (2006) depicting a much simpler model featuring the inclusion of the harmless workaround which would not affect data accuracy.

A study by Vogelsmeier et al. (2008) documented that nurses using an eMAR used workarounds as “problem-solving behaviors” to bypass hindering technology so as to “minimize disruption in work flow”. This is a good illustrative example of Ferneley and Sobreperez’s (2006) hindrance workaround with the level of resistance being debatable. The nurse could state that it is positive resistance given the goal to improve working practices, but an administrator may consider it to be negative resistance if the workaround was the deliberate omission of a mandated workflow procedure.

The goal of Vogelsmeier et al.'s (2008) study was to describe the nature of eMAR workarounds within a nursing home setting and to identify the potential risks that the workarounds posed for medication safety. The result was the determination that the main causes of workarounds were due to "technological design" and the "failure to reengineer related processes". The risks reported were that staff would revert to "pretechnology" actions such as using hand written medication cards and patient information notes or consulting other staff. In some instances in which the technology was used inappropriately, nurses would re-write a physician's multiple page order onto a single page; or if a high drug strength was not in the system, the nurses falsely documented that multiple doses of the lower strength of that drug was used.

Tucker and Feldman (2004) reported that workarounds were used by nurses to overcome system failures. It was documented that a failure occurred, on average, every 74 minutes. These failures caused nurses to spend an additional 3 to 10 minutes to work around the problem. This extra time was a byproduct of the additional 1 to 4 steps of the workaround procedure. From an administrative view, it was estimated that $95 per hour per nurse was lost as a result of the failures. This estimate was extrapolated to a hypothetical 204-bed hospital with 75% occupancy. The results were sobering; a minimum of $51,000 up to a maximum of $27 million could be lost per year as a result of operational failures. It is worth noting that job satisfaction could also be affected by system failures. Their projected cost figures did not include any estimation of nurse turnover and the cost associated with having to train new nurses.

This potential cost associated with the use of workarounds has also been addressed by Petrides et al. (2004). In their study, Petrides and colleagues discussed the time that staff spent engaged in using workarounds and their subsequent lost productivity. Their findings suggested that significant hidden costs and an excessive amount of time and resources were needed in performing workarounds that were considered necessary to perform the users' jobs. Individual or department specific issues which were addressed by workarounds were claimed to be justified by the authors. The justification was due to the consideration of the potential cost to the system had a new information system been implemented for such specific issues.

Several studies have examined specific technologies and published descriptions, some very detailed, of workarounds that the users performed during the course of working with patients. Patterson et al. (2004; 2006), covered bar code medication administration (BCMA) systems in two papers and authors Phillips and Berner (2004) did as well. Koppel et al. (2005) published a paper detailing the errors and workarounds associated with a computerized prescriber order entry system. Similarly, Obradovich & Woods (2006) paper detailed the interface, workarounds, and errors associated with an undisclosed medication infusion pump used to treat pre-term labor in women with high risk pregnancies. Each of these studies were incredibly valuable to their respective device vendors, organization administration, and end users as they illuminated potentially unknown system shortcomings. Addressing those identified issues could be valuable to all parties involved by improving the systems' efficiency and safety.

As previously described, existing studies examining workarounds associated with specific technologies help us better understand how workarounds are used with certain types of technologies. Though, their applications may be limited because health care organizations generally utilize more than one type of technology. In other words, existing research investigating one technology at a time may not provide a complete view of workarounds in organizations in which more than one technology is concurrently used. Furthermore, since existing studies have been conducted in institutional settings, more research examining workarounds in pharmacies is warranted. Therefore, building on existing research in workaround use, this study's goal was to better understand the relationships between various factors (staff characteristics, general pharmacy characteristics, and technology characteristics) and workaround use among various technologies in pharmacies.

## 2.2. Research Problem

What factors affect the use of workarounds being utilized during prescription preparation in pharmacies?

## 2.3. Research Question

What are the identifiable subgroups of respondents that differ in the use of workarounds?

## 2.4. Purpose of Study

To determine the workaround use in pharmacies as reported by respondents.

To determine the relationship between selected variables (staff characteristics, general pharmacy characteristics, and technology characteristics) and the workaround use in pharmacies reported by respondents.

# Chapter 3: METHODOLOGY

## 3.1. Rationale of Methodology

This study was a non-experimental, exploratory survey of workarounds used during the prescription preparation process of pharmacies in Alabama. A questionnaire was sent to a random sample of pharmacy technicians and pharmacists registered with the Alabama Board of Pharmacy. The questionnaire assessed the respondents' workaround use at their pharmacy practice setting in an attempt to determine which, if any, factors were associated with the existence or quantity of workarounds reported. The study also sought to determine if the responses from pharmacy technicians differed from those of the pharmacists in an effort help to better tailor future research conducted in this area in the future.

A survey method was utilized in this study for several reasons. First, a questionnaire is less costly compared to observations and interviews. Second, a survey method can gather information from multiple practice settings, which, in turn, allows the results to be generalizable. The alternative study approaches such as observation and interview, despite their strengths, carry a heavy cost in terms of resources in order to achieve a moderate level of generalization. The questionnaire affords the opportunity to efficiently document the existence of the workaround phenomenon in multiple pharmacy settings in addition to analyzing for specific relationships within the variables of interest. The information obtained by this study can be an asset to strengthen future research in this area.

## 3.2. Population and Sampling

### 3.2.1. Study Population

The target population was registered pharmacy staff (technicians and pharmacists) who work in pharmacies that fill, dispense, or prepare prescriptions or medication orders in the state of Alabama.

### 3.2.2. Sample

A random sample of 600 potential participants, 300 pharmacy technicians and 300 pharmacists, was generated from a list of the assumed entire population of pharmacy technicians ($N$ = 10,145) and pharmacists ($N$ = 6,291) registered with the Alabama Board of Pharmacy in the spring of 2008. Group assignments were based upon job title, either pharmacy technician or pharmacist.

#### 3.2.3. Risks and Precautions of Participation

Risks: No risks related to confidentiality of participants' responses were anticipated. Due to the nature of the anonymity of the questionnaire used in this study, the researcher was not able to identify individual respondents or the specific organizations which they work for based upon their answers to the questionnaire. However, participants may experience some discomforts disclosing workaround actions. This is because the use of pharmacy workarounds, such as fraudulent billing practices, drug diversion, and patient safety concerns, may have legal and administrative ramifications.

Precautions: Response to the questionnaire was entirely voluntary and anonymous. No identifying information was asked of respondents and questionnaires were not coded, numbered, or marked in any way to identify the origin of the participants.

#### 3.2.4. Participant Compensation

No compensation was given to participants.

### 3.3. Data Collection Method

#### 3.3.1. Materials

A total of 600 potential participants were sent an initial postcard communication, questionnaire packet, reminder postcard, and replacement questionnaire packet between October, 2008, and January, 2009. Each communication included information for the option of completing the questionnaire online in addition to the availability of the paper version. Both questionnaires (packet and online version) had the same questions with a similar visual appearance. They were identical in content; both had an introduction to the study, an IRB approved information letter, and a complete questionnaire.

**3.3.2. Method**

The Alabama Board of Pharmacy assisted the researcher by providing the registered mailing addresses of the pharmacy technicians and pharmacists registered in the state of Alabama. Using a random number generator and referencing the row number of the individuals listed in the Microsoft ® Office Excel 2007 spreadsheets, a random sample of 300 pharmacy technicians and 300 pharmacists were drawn to request participation in the study. Each potential participant was contacted via the U.S. postal service requesting that they complete the pharmacy workaround questionnaire (see Appendix A) either in the online format which was available via surveymonkey.com, or a paper version.

Initial contact with participants was in the form of a postcard (see Appendix B) providing a brief overview of the study, notice that a paper version of the questionnaire would be mailed to them in a couple of weeks, the URL (or web address) to access the online version of the study materials, and the researcher's contact information for questions or to opt out of the follow-up mailings.

The second mailing (see Appendix A) included a study introduction cover letter, an IRB approved information letter, a paper version of the workaround questionnaire, a pre-addressed stamped return envelope, the URL (or web address) to access the online version of the study materials, and the researcher's contact information for questions or to opt out of the follow-up mailings.

The third mailing was a composite thank you/reminder postcard (see Appendix C) for responding to the study request. It was similar in content to the initial contact postcard providing a brief overview of the study, notice that a paper version of the questionnaire would be mailed to them within a couple of weeks, the URL (or web address) to access the online study materials, and the researcher's contact information for questions or to opt out of the follow-up mailings. The difference was that the greeting of this postcard served as a thank you to the participant for completing the questionnaire and then as a reminder to complete the questionnaire in the event that they had not yet responded.

The fourth and final mailing was an exact duplication of the second mailing including a study introduction cover letter, an IRB approved information letter, a paper version of the workaround questionnaire, a pre-addressed stamped return envelope, the URL or web address to access the online version of the study materials, and the researcher's contact information for questions.

Participants were encouraged to contact the researcher either by email or telephone at anytime with questions about the research project or to request that they no longer receive any more correspondence about the study. No reason needed to be given to opt out of future mailings and no indication as to whether the participant had chosen to complete the questionnaire or not was necessary.

### 3.4. Storage and Protection of Data

The raw data were stored on hard copy (paper responses) in a key locked cabinet in the researcher’s absence and on the primary researcher's computer (online responses and complete response database). The principle researcher and the Pharmacy Care Systems Department secretary were the only two individuals with access to the key to the file cabinet. The researcher's computer was protected by a user-name and password containing alpha and numeric characters. An additional layer of protection extended to the participants was that the online questionnaire host, surveymonkey.com, did not collect respondents e-mail addresses or IP addresses.

### 3.5. Variables

All variables were measured using the questionnaire (see Appendix A) and are presented in Table 1. These variables can be classified into four groups: staff characteristics, general pharmacy characteristics, technology characteristics and dependent variables.

**Table 1.**

**Variables, Operational Definitions and Measurements**

| Variable | Operational Definitions – Survey Items | Measurement |
|---|---|---|
| Staff characteristics | | |
| Age | Respondent's age in years | Free Text<br>Numerical |
| Gender | Respondent's gender:<br>• Female<br>• Male | Coded:<br>0<br>1 |
| Job title | Respondent's job title:<br>• PharmD<br>• BS Pharm<br>• Certified Pharmacy Technician (CPhT)<br>• Pharmacy Technician<br>• Other | Coded:<br>1<br>2<br>3<br>4<br>5 |
| Experience | Quantity of years the respondent indicated they had their job title | Free Text<br>Numerical |
| Leadership position | Respondent who had a position in charge; pharmacist-in-charge or head/senior technician:<br>• No<br>• Yes | Coded:<br>0<br>1 |
| Leadership experience | Quantity of years a respondent indicated they had leadership position | Free Text<br>Numerical |
| General pharmacy characteristics | | |
| Practice setting | Respondent's primary pharmacy practice setting:<br>• Corporate Community<br>• Independent Community<br>• Hospital Inpatient<br>• Hospital Outpatient<br>• Other | Coded:<br>1<br>2<br>3<br>4<br>6 |
| Daily prescription volume | Average quantity of prescriptions filled at the respondent's pharmacy in 24 hours:<br>• 100 or Less<br>• 101 – 200<br>• 201 – 300<br>• 301 – 400<br>• 401 – 500<br>• 501 – 1000<br>• 1001 – 2000<br>• 2001 or More | Coded:<br>2<br>3<br>4<br>5<br>6<br>7<br>9<br>10 |
| Technology characteristics | | |
| Quantity of computers | Quantity of computers in the respondent's pharmacy | Free Text<br>Numerical |
| Type of technology available | A type of technology in the respondent's pharmacy that was available for use during prescription preparation:<br>• No<br>• Yes | Coded:<br>0<br>1 |

| Variable | Operational Definitions – Survey Items | Measurement |
|---|---|---|
| *Quantity of types of technology (derived) | The summed total of the types of technology available that was derived from the respondent's workaround use frequency. | Mathematically Calculated |
| *Quantity of types of technology (indicated) | The summed total of the types of technology available that was specifically indicated by respondent. | Mathematically Calculated |
| Level of technology integration | The respondent's perceived percentage of integration between the types of technology in their pharmacy:<br>• 0% Not at all<br>• 25% Integrated<br>• 50% Integrated<br>• 75% Integrated<br>• 100% Perfectly | Coded:<br>0<br>1<br>2<br>3<br>4 |
| Dependent Variables | | |
| Workaround use frequency | The respondent's perceived frequency of workaround use with a specific type of technology available in their pharmacy:<br>• Never<br>• Infrequently<br>• Frequently<br>• Very frequently<br>• Every time | Coded:<br>0<br>1<br>2<br>2<br>4 |
| *Average workaround frequency | The respondent's average perceived frequency of workaround use across all types of technology available in their pharmacy. | Mathematically Calculated |

Note. *Calculated variable

### 3.6. Data Analysis

Descriptive statistics were used to describe the study participants. Bivariate statistics (e.g., *t*-test, correlations, ANOVA) were used to determine associations between variables. A CHAID tree analysis was conducted to determine if clusters of variables could be differentiated based upon the workaround use reported by the respondents. All data were presented in aggregate.

# Chapter 4: RESULTS

## 4.1. Response Rate and Nonresponse Bias

There were a total of 145 responses to the requests to participate in this study. Of the 145 responses, two responders stated that they wanted to be removed from subsequent mailings without indicating whether they had completed the questionnaire; three did not want to participate in the research; 11 indicated that they chose not to respond due to a job change, retirement, or some other similar reason that would affect their ability to answer the questions; and 28 mailed requests were returned to the sender due to an invalid recipient address. The total response rate was calculated by first deducting the 39 ineligible responses (11 + 28) from the total sample of 600 to yield a corrected eligible sample of 561. The two respondents who did not indicate whether they participated were not included in the rate calculation yielding a corrected total response of 143. The corrected total response was then divided by the corrected sample (143/561) and then multiplied by 100% to give a response rate of 25.5%.

Regarding nonresponse bias, an analysis of early versus late responders was conducted to determine the potential for response bias. The first 25% of the respondents' answers were compared to the last 25% of the respondents' answers to see if a difference was detectable. Among various staff characteristics, general pharmacy characteristics and technology characteristics, only one statistically significant finding was found between early and late responders. Specifically, the contingency coefficient calculated for job title and early or late response was $C(71) = .356$, $p = .016$, which means that 12.7% of the variance in whether a respondent was in the first 25% or the last 25% was explained by the variance in job title.

## 4.2. Descriptive Statistics

### 4.2.1. Descriptions of Staff Characteristics

Table 2 describes the demographics of the survey respondents. The majority of responders (70%) indicated that they were pharmacists. About 60% of total respondents were female; specifically 52.5% and 83.3% were female among the pharmacists and the technicians, respectively. Pharmacists who had a BS Pharm were the largest group of responders at 47.6%, followed by those who had a PharmD with 22.4%, followed by the general pharmacy technicians at 16.8%, and then by the nationally Certified Pharmacy Technicians (CPhT) at 12.6%. Of the 143 responders, 37.1% indicated that they were in leadership positions such as the pharmacist-in-charge (PIC) (40.6% of the pharmacists) or the head/senior technician (28.6% of the technicians). The average age of the respondents was 43.96 (*SD* = 15.32) with the average pharmacist’s age being 46.90 (*SD* = 14.46) and average technician’s age being 34.04 (*SD* = 14.05). The average number of years as the pharmacist-in-charge was 8.64 (*SD* = 10.09) and the head/senior technician was 5.04 (*SD* = 4.14).

**Table 2.**

**Staff, General Pharmacy, and Technology Characteristics**

| | All | Pharmacists | Technicians |
|---|---|---|---|
| | *n*[a](%) | *n*[a](%) | *n*[a](%) |
| **Staff Characteristics** | | | |
| Gender | | | |
| Male | 54 (38.0) | 47 (47.4) | 7 (16.7) |
| Female | 88 (62.0) | 52 (52.5) | 35 (83.3) |
| Job title | | | |
| PharmD | 32 (22.4) | 32 (32.0) | |
| BS Pharm | 68 (47.6) | 68 (68.0) | |
| Nationally Certified Pharmacy Technician | 18 (12.6) | | 18 (42.9) |
| Pharmacy Technician | 24 (16.8) | | 24 (57.1) |
| Other | 1 (0.7) | | |
| Position in charge (Leadership) | | | |
| Yes | 53 (37.1) | 41 (40.6) | 12 (28.6) |
| No | 90 (62.9) | 60 (59.4) | 30 (71.4) |
| **General Pharmacy Characteristics** | | | |
| Practice setting | | | |
| Corporate Community Pharmacy | 73 (51.4) | 45 (45.5) | 28 (66.7) |
| Independent Community Pharmacy | 31 (21.8) | 22 (22.2) | 9 (21.4) |
| Hospital Inpatient Pharmacy | 24 (16.9) | 22 (22.2) | 2 (4.8) |
| Hospital Outpatient Pharmacy | 3 (2.1) | 3 (3.0) | 0 (0) |
| Other | 11 (7.7) | 7 (7.1) | 3 (3.0) |
| Prescription volume per day | | | |
| 100 or Less | 15 (10.6) | | |
| 101-200 | 33 (23.4) | | |
| 201-300 | 39 (27.7) | | |
| 301-400 | 21 (14.9) | | |
| 401-500 | 7 (5.0) | | |
| 501-1000 | 13 (9.2) | | |
| 1001-2000 | 7 (5.0) | | |
| 2001 or More | 6 (4.3) | | |

| | All | Pharmacists | Technicians |
|---|---|---|---|
| **Technology Characteristics** | | | |
| Level of technology integration in pharmacy | | | |
| 0% Not at all | 17(12.3) | | |
| 25% Integrated | 16 (11.6) | | |
| 50% Integrated | 20 (14.5) | | |
| 75% Integrated | 40 (29.0) | | |
| 100% Perfectly integrated | 45 (32.6) | | |
| | Mean (*SD*) | Mean (*SD*) | Mean (*SD*) |
| Age (years) | 43.96 (15.32) | 46.90 (14.46) | 34.04 (14.05) |
| Years in practice (Experience) | 12.46 (13.23) | 15.62 (14.95) | 4.35 (4.43) |
| Years as a person in charge[a] (Leadership Experience) | | 8.64 (10.09) | 5.04 (4.14) |
| Quantity of computer terminals in pharmacy | 5.50 (4.49) | | |
| Quantity of types of technology (indicated) in the pharmacy | 4.47 (1.69) | | |
| Quantity of types of technology (derived) in the pharmacy | 8.122.89) | | |

Note. [a]Total may vary due to missing data.

### 4.2.2. Descriptions of General Pharmacy Characteristics

Table 2 also describes the pharmacies at which the respondents practice. Most respondents were from the corporate community pharmacy setting at 51.4%, followed by independent community pharmacy at 21.8%, followed by hospital inpatient pharmacy at 16.9%, followed by the “other” group at 7.7%, and lastly by hospital outpatient pharmacy group at 2.1%. The other group was composed of clinical outpatient pharmacy, grocery store pharmacy, long term care pharmacy, mail order pharmacy, and a specialty (renal) pharmacy. Further, the largest category of daily prescription volume selected was the 201-300 prescription per day choice at 27.7%, followed by the 101-200 prescriptions per day group at 23.4%, followed by the 301-400 prescriptions per day group at 14.9%, followed by the 100 or less prescriptions per day group at 10.6%, and the other four prescription per day groups had less than 10% of the respondents per group ranging from 4.3% (2001 or more) to 9.2% (501-1000).

### 4.2.3. Descriptions of Technology in the Pharmacy

Table 2 also quantifies the technological composition of the respondent's pharmacies. The most frequently chosen category for the pharmacy's level of technology integration chosen by respondents was 100% perfectly integrated at 32.6%, followed by 75% integrated at 29.0% of respondents, followed by 50% integrated at 14.5% of respondents, followed by 12.3% of respondents who claimed that their pharmacy was not integrated at all (0% integrated), and the smallest group was the 25% integrated group at 11.6%. The average quantity of computer terminals in the pharmacy was 5.50 (*SD* = 4.49) and the average quantity of the types of technology (indicated) in the pharmacy was 4.47 (*SD* = 1.69). An additional method was used to determine an accurate count of the different types of technology by using the response to the workaround frequency questions. If a respondent chose any of the frequency categories for a type of technology then that was counted as one type of technology. The sum of all the different types of technology from the workaround frequency questions was then calculated and used in analyses separately. The average quantity of the types of technology based on the workaround responses was 8.12 (*SD* = 2.89) and was termed the quantity of types of technology (derived).

Table 3 describes the availability of the technology and additional technological functionality of the pharmacies specifically indicated by the respondents. Of these types of technologies, faxing capabilities was the most selected by respondents at 97.2%, followed by voicemail or answering machines at 73.9%, followed by bar code scanners at 71.1%, followed by electronic prescription capabilities at 60.6%, followed by the use of prescription scanners at 59.2%, and the least reported was radio frequency identification (RFID) at 5.6%. The most common additional technology functionalities reported were the use of online pharmacy or medical resources at 95.6% of respondents, followed by access to the Internet or intranet at 83.0%, followed by the ability to view a patient's off-site or multiple facility central profile at 61.3% of respondents. Personal Digital Assistants (PDA) and smart phones were indicated as being supplied by the pharmacy to 9.4% of respondents and 23.0% indicated that they provide their own personal device to use at their place of practice.

**Table 3.**

**Availability of technology in pharmacy by type**

| Type of Pharmacy Technology | Availability of Technology in Pharmacy | |
|---|---|---|
| | Available n (%)[a] | Not available n (%)[a] |
| Technology in Pharmacy | | |
| Automated counting device | 33 (23.2) | 109 (76.8) |
| Radio Frequency Identification (RFID) | 8 (5.6) | 134 (94.4) |
| Automated dispensing device | 29 (20.4) | 113 (79.6) |
| Electronic prescription capabilities | 86 (60.6) | 56 (39.4) |
| Bar code scanner | 101 (71.1) | 41 (28.9) |
| Voicemail or answering machine | 105 (73.9) | 37 (23.9) |
| Prescription scanner | 84 (59.2) | 58 (40.8) |
| Unit dose packer/sealer | 41 (28.9) | 101 (71.1) |
| Faxing capabilities | 138 (97.2) | 4 (2.8) |
| Other Technology | 10 (7.0) | 132 (93.0) |
| Additional Technological Functionality | | |
| Central patient profile | 76 (61.3) | 48 (38.7) |
| Internet or intranet | 117 (83.0) | 24 (17.0) |
| Online pharmacy or medical resources | 129 (95.6) | 6 (4.4) |
| Personal PDA/smart phone | 32 (23.0) | 107 (77.0) |
| Company provide PDA/smart phone | 13 (9.4) | 126 (90.6) |

Note. [a]Total may vary due to missing data.

### 4.2.4. Descriptions of Workaround Use

Table 4 shows the frequency of the respondents who chose a workaround frequency category for its corresponding technology indicating workaround use. The table also shows the number of respondents that indirectly indicated they had this type of technology by simply choosing a workaround frequency choice. If the respondent chose any other option besides “never” to “every time” then this was scored as the respondent not having that technology available in the pharmacy. The technology with the most derived availability among respondents was faxing capabilities at 94.4%, followed by the pharmacy management software at 83.9%, followed by online pharmacy or medical resources at 82.5%, followed by general Internet accessibility 78.3%, followed by voicemail or an answering machine at

75.5%. Another group of derived highly available technology was electronic prescribing at 69.9%, bar code scanners for prescription filling at 68.5%, bar code scanners for verification at 67.8%, and prescription scanners at 62.2%.

**Table 4.**

**Frequency of workaround use by technology type**

| Technology Type | Workaround Use $n^a$(%) | | | | | |
|---|---|---|---|---|---|---|
| | Never | Infrequently | Frequently | Very Frequently | Every time | Technology Available |
| Prescription Input Technology | | | | | | |
| Pharmacy management software | 23 (19.2) | 60 (50.0) | 20 (16.7) | 12 (10.0) | 5 (4.2) | 120 (83.9) |
| Electronic prescribing | 30 (30.0) | 41 (41.0) | 13 (13.0) | 10 (10.0) | 6 (6.0) | 100 (69.9) |
| Prescription scanner | 29 (32.6) | 43 (48.3) | 7 (7.9) | 4 (4.5) | 6 (6.7) | 89 (62.2) |
| Internet accessibility | 31 (27.7) | 54 (48.2) | 14 (12.5) | 8 (7.1) | 5 (4.5) | 112 (78.3) |
| Faxing capability | 45 (33.3) | 52 (38.5) | 19 (14.1) | 14 (10.4) | 5 (3.7) | 135 (94.4) |
| Prescription Filling Technology | | | | | | |
| Automated dispensing machine | 9 (23.1) | 17 (43.6) | 10 (25.6) | 2 (5.1) | 1 (2.6) | 39 (27.3) |
| Radio Frequency Identification (RFID) | 10 (58.8) | 5 (29.4) | 2 (11.8) | 0 (0) | 0 (0) | 17 (11.9) |
| Bar code scanner (filling) | 26 (26.5) | 45 (45.9) | 10 (10.2) | 13 (13.3) | 4 (4.1) | 98 (68.5) |
| Unit dose packer/sealer | 0 (0) | 15 (32.6) | 6 (13.0) | 6 (13.0) | 1 (2.2) | 46 (32.2) |
| Automated TPN compounder | 10 (47.6) | 6 (28.6) | 3 (14.3) | 2 (9.5) | 0 (0) | 21 (14.7) |
| Counting device | 11 (30.6) | 18 (50.0) | 6 (16.7) | 1 (2.8) | 0 (0) | 36 (25.2) |
| Pharmacist Specific Technology | | | | | | |
| Voicemail/answering machine | 51 (47.7) | 36 (33.6) | 8 (7.5) | 10 (9.3) | 2 (1.9) | 108 (75.5) |
| Online pharmacy or medical resources | 43 (36.8) | 47 (40.2) | 18 (15.4) | 8 (6.8) | 1 (0.9) | 118 (82.5) |
| Company provided Personal Digital Assistant (PDA) | 7 (28.0) | 12 (48.0) | 2 (8.0) | 3 (12.0) | 1 (4.0) | 25 (17.5) |
| Bar code scanner (verification) | 29 (30.2) | 45 (46.9) | 8 (8.3) | 12 (12.5) | 2 (2.1) | 97 (67.8) |

Note. [a]Total may vary due to missing data.

Table 4 also shows that for the prescription input technology section (including pharmacy management software, electronic prescribing, prescription scanners, Internet accessibility, and faxing capabilities), the most selected frequency of workarounds was infrequently and the least selected category was every time (with the exception of the prescription scanner workarounds having very frequently as the least).

The prescription filling technology group was not as uniform. Workarounds with automated dispensing machines, bar code scanners, unit/sealer machines, and counting devices also fit the above pattern of infrequently being the workaround frequency category most chosen by respondents and every time being the least chosen. Radio frequency identification and the automated total parenteral nutrition (TPN) compounders had low availability among the respondents and had similar patterns of frequency of workaround use with these technologies by most respondents indicating that they never use workarounds and the least selecting the very frequently to every time categories.

The pharmacist specific technology also fit the pattern of infrequently being the most chosen frequency and every time being the least chosen frequency by respondents for all technology types except voicemail. Most respondents indicated they never used workarounds with voicemail and the least amount of respondents selected the frequency category was every time.

## 4.3. Relationships Among Variables

There were several analyses that were significant among the variables of interest pertaining to the respondents themselves, their pharmacy, or workarounds. A list of variables and their statistics are displayed in Table 2. To simplify the presentation, only those results that were statistically significant are presented in this report.

### 4.3.1. Staff Characteristics

Table 5 shows the results of the Oneway Analysis of Variance (ANOVA) based on the respondent's gender. Statistical differences were found between males and females in age ($F[1, 98] = 18.49$, $p \leq .001$), experience ($F[1, 137] = 17.67$, $p \leq .001$), and leadership experience as the pharmacist-in-charge ($F[1, 34] = 9.68$, $p \leq .01$). The male respondents, on average, were older and had more experience, and if they were the pharmacist-in-charge, they tended to have more time in that role than the female respondents. Relationships among age, experience, leadership experience as the pharmacist-in-charge, and leadership experience as the head/senior technician were further explored (results not shown in table). The Pearson correlation coefficient ($r$) for respondent age and experience was statistically significant, $r(98) = .695$, $p \leq .001$. This means that 48.3% of the variance in the respondent's experience was accounted for by the variance in the respondent's age. Put another way, the older the respondent the longer the amount of time they had with their job title. The Pearson correlation coefficient ($r$) for respondent age and the leadership experience as the pharmacist-in-charge was statistically significant, $r(29) = .607$, $p \leq .001$, which means that 36.8% of the variance in the respondent's leadership experience as the pharmacist-in-charge is due to the variance in the respondent's age. The older the respondent was, the longer their reported time as a pharmacist-in-charge. There was also a significant difference found between experience and the leadership experience as the pharmacist-in-charge, $r(36) = .692$, $p \leq .001$. This means that 47.9% of the variance in the leadership experience as the pharmacist-in-charge is explained by the variance in their experience (overall). This is similar in concept to that above, the longer the amount of time with their job title the longer they reported their time as being a pharmacist-in-charge. And lastly, there was a significant finding of the relationship between experience and the leadership experience as a head/senior technician. The Pearson correlation coefficient was $r(10) = .901$, $p \leq .001$, which means that 81.1% of the variance of the leadership experience as a senior technician is explained by their experience (overall). As before, the longer the amount of time a respondent had with their job title the longer their reported their time as a senior technician.

**Table 5.**

**Comparison of staff characteristics between male and female respondents**

| | Gender | | | |
|---|---|---|---|---|
| | Male | Female | *df* | *F* |
| Age (years) | 51.10 (17.14) | 38.79 (11.47) | 1, 98 | 18.49*** |
| Experience (years) | 18.19 (17.07) | 8.99 (8.66) | 1, 137 | 17.67*** |
| Leadership experience as the Pharmacist in Charge (years) | 13.59 (12.57) | 4.21 (3.72) | 1, 34 | 9.68** |

Note. ** = $p \leq .01$, *** = $p \leq .001$. Standard deviations appear in parentheses below means.

Table 6 compares staff characteristics and technology characteristics between pharmacists and technicians. There was a statistical difference between pharmacists and pharmacy technicians in age ($F[1, 97] = 14.19$, $p \leq .001$), experience ($F[1, 137] = 26.39$, $p \leq .001$), and the quantity of computers in the pharmacy ($F[1, 136] = 6.98$, $p \leq .01$). The pharmacists, on average, were older, had more experience, and had more computers in the pharmacy than the technicians that responded.

**Table 6.**

**Comparison of staff and technology characteristics between pharmacists and pharmacy technicians**

| | Pharmacist or Technician | | | |
|---|---|---|---|---|
| | Pharmacist | Technician | *Df* | *F* |
| Age (years) | 47.15 (14.52) | 34.73 (14.21) | 1, 97 | 14.19*** |
| Experience (years) | 15.90 (14.12) | 4.18 (4.50) | 1, 137 | 26.39*** |
| Quantity of Computers in Pharmacy | 6.11 (5.125) | 3.95 (1.60) | 1, 136 | 6.98** |

Note. ** = $p \leq .01$, *** = $p \leq .001$. Standard deviations appear in parentheses below means.

Table 7 shows the differences in staff characteristics and the general pharmacy characteristics among various job titles. A relationship was identified between respondent age and their job title ($F[3, 95] = 24.12$, $p \leq .001$). The Least Significant Difference (LSD) post hoc test found a significant difference between the BS Pharm group and all other groups ($p \leq .05$). Specifically, there was an average difference of greater than 20 years between those respondents with BS Pharm degrees and those with either a PharmD degree or were basic pharmacy technicians. Further, the difference between the BS Pharm group and the certified pharmacy technician (CPhT) group was a little over 18 years.

**Table 7.**

**Comparison of staff characteristics between job titles**

| | Job Title | | | | | |
|---|---|---|---|---|---|---|
| | PharmD | BS Pharm | CPhT | Pharmacy Technician | *df* | *F* |
| Age (years) | $33.96_a$ (8.73) | $54.45_b$ (11.65) | $36.30_a$ (11.06) | $33.75_a$ (16.14) | 3, 95 | 24.12*** |
| Experience (years) | $6.00_a$ (4.83) | $20.63_b$ (14.65) | $5.65_a$ (6.10) | $3.09_a$ (2.44) | 3, 135 | 24.81*** |

Note. *** = $p \leq .001$. Standard deviations appear in parentheses below means. Results of LSD post hoc paired comparisons are shown using subscripts (a, b). Means with the same subscript are not significantly different while means with different subscripts are significantly different from one another at the $p \leq .05$.

Similarly, Table 7 also shows that the BS Pharm group was also significantly different from the other job title groups in experience ($F$[3, 135] = 24.81, $p \leq .001$). On average, the BS Pharm respondents had over 17 years more experience than the basic pharmacy technician and almost 15 years more experience than the certified pharmacy technicians. The respondents that indicated they were in the BS Pharm group had more than 14 years experience than their pharmacist counter parts, the PharmD group.

### 4.3.2. Pharmacy and Technology Characteristics

Table 8 displays the results of the comparisons of staff characteristics and general pharmacy characteristics among various types of practice settings. There were statistically significant differences between practice setting groups and experience ($F$[4,134] = 3.31, $p \leq .05$), the quantity of computers in the pharmacy ($F$[4, 133] = 12.49, $p \leq .001$), and the quantity of the types of technology (indicated) in the pharmacy ($F$[4, 136] = 9.27, $p \leq .001$). Respondents from independent community pharmacies had the most experience ($M$ = 18.53, $SD$ =

18.57), while those from corporate community pharmacies had the least experience (*M* = 9.62, *SD* = 11.12). Hospital pharmacies, both inpatient (*M* = 15.35, *SD* = 10.32) and outpatient (*M* = 14.00, *SD* = 14.42), were in the middle of the range of experience. In terms of the quantity of computers in the pharmacy, hospital outpatient (*M* = 13.00, *SD* = 11.31) and inpatient (*M* = 9.58, *SD* = 6.20) had more computers in the pharmacy than the corporate community (*M* = 4.29, *SD* = 1.96) or independent community pharmacies (*M* = 3.72, *SD* = 1.44) reported. Lastly, the corporate community pharmacy (*M* = 5.12, *SD* = 1.36) had the most types of technology (indicated) while the hospital outpatient setting (*M* = 2.33, *SD* = 1.53) had the fewest.

**Table 8.**

**Comparisons of staff and pharmacy characteristics between practice settings**

| | Practice Setting | | | | | | |
|---|---|---|---|---|---|---|---|
| | Corporate Community | Independent Community | Hospital Inpatient | Hospital Outpatient | Other | df | F |
| Experience | $9.62_{a}$ (11.12) | $18.53_{b}$ (18.57) | $15.35_{ab}$ (10.32) | $14.00_{ab}$ (14.42) | $7.32_{ab}$ (7.44) | 4, 134 | 3.31* |
| Quantity of Computers in Pharmacy | $4.29_{ab}$ (1.96) | $3.72_{ab}$ (1.44) | $9.58_{c}$ (6.20) | $13.00_{c}$ (11.31) | $7.55_{ac}$ (8.18) | 4, 133 | 12.49** * |
| Quantity of Types of Technology (indicated) | $5.12_{a}$ (1.6) | $3.33_{b}$ (1.69) | $4.17_{ab}$ (1.90) | $2.33_{b}$ (1.53) | $4.36_{ab}$ (1.03) | 4, 136 | 9.27*** |

Note. * = p ≤ .05, *** = p ≤ .001. Standard deviations appear in parentheses below means. Results of LSD post hoc paired comparisons are shown using subscripts (a, b, c). Means with the same subscript are not significantly different while means with different subscripts are significantly different from one another at the p ≤ .05.

Further analyses were conducted to assess the relationships among prescription volume, quantity of computers and the quantity of types of technology (results not shown in table). A significant Spearman correlation was found between daily prescription volume and the quantity of computers in the pharmacy ($\rho[137] = .624$, $p \leq .000$) and the quantity of the types of technology (indicated) ($\rho[140] = .294$, $p \leq .000$). The variance in daily prescription volume accounted for 38.9% of the variance in the quantity of the computers in the pharmacy and 8.6% of the variance in the quantity of the types of technology (indicated). This indicates that as the average daily prescription volume increases, the quantity of computers in the pharmacy and the quantity of the types of technology (indicated) increases.

Table 9 displays the results of the comparisons of technology characteristics based on prescription volume. There was a significant difference between groups of prescription volume based on the quantity of computers in the pharmacy ($F[7, 129] = 20.31$, $p \leq .001$), the quantity of the types of technology (indicated) ($F[7, 132] = 4.01$, $p \leq .01$), and the quantity of the types of technology (derived) ($F[7, 133] = 2.34$, $p \leq .05$). The general trend of means shows the quantity of computers in the pharmacy increases as prescription volume increases. However, there was not a general trend present in the quantity of the types of technology, both those indicated and derived, based upon the pharmacy's daily prescription volume.

**Table 9.**

**Comparisons of technology characteristics between daily prescription volume**

| | Daily Prescription Volume | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 100 or less | 101-200 | 201-300 | 301-400 | 401-500 | 501-1000 | 1001-2000 | 2001 or more | df | F |
| Quantity of Computers in Pharmacy | $3.23_{a}$ (2.39) | $3.82_{a}$ (3.19) | $4.42_{ab}$ (1.91) | $5.05_{ab}$ (2.21) | $6.14_{abc}$ (2.34) | $7.31_{bc}$ (2.50) | $9.43_{c}$ (5.47) | $19.00_{d}$ (9.08) | 7, 129 | 20.31*** |
| Quantity of Types of Technology (indicated) | $3.27_{a}$ (1.22) | $4.33_{bce}$ (1.38) | $4.26_{be}$ (1.89) | $5.15_{cd}$ (1.76) | $6.14_{d}$ (1.35) | $5.15_{bcde}$ (1.52) | $3.71_{ab}$ (0.95) | $5.50_{cde}$ (1.05) | 7, 132 | 4.01** |
| Quantity of Types of Technology (derived) | $6.73_{a}$ (2.55) | $8.03_{ab}$ (2.19) | $7.41_{ac}$ (3.35) | $9.62_{d}$ (3.69) | $9.57_{bcd}$ (1.72) | $9.00_{bcd}$ (1.53) | $8.43_{abd}$ (1.51) | $9.00_{abd}$ (1.67) | 7, 133 | 2.34* |

Note. * = $p \leq .05$, ** = $p \leq .01$, *** = $p \leq .001$. Standard deviations appear in parentheses below means. Results of LSD post hoc paired comparisons are shown using subscripts (a, b, c, d, e). Means with the same subscript are not significantly different while means with different subscripts are significantly different from one another at the $p \leq .05$

Further, a Spearman correlation indicated that the relationships between the level of technology integration and the quantity of computer terminals in the pharmacy ($\rho[135] = .224$, $p \leq .009$) and the quantity of the types of technology (indicated) ($\rho[138] = .511$, $p \leq .000$) were significant (results not shown). The variance in level of technology integration accounted for 5.0% of the variance in the quantity of computer terminals and 26.1% of the variance in the quantity of the types of technology (indicated). It also shows that as the level of technology integration increases, the quantity of computers in the pharmacy slightly increases and that the quantity of the types of technology (indicated) increases.

A Pearson correlation coefficient did not indicate a significant relationship between the quantity of computer terminals and the quantity of the types of technology (indicated) but a Spearman correlation did ($\rho[139] = .271$, $p \leq .001$). This means that 7.3% of their variance is shared. It also indicates a general trend of one variable increasing as the other variable increases.

Table 10 assesses the relationships between the level of technology integration and the quantity of the types of technology in the pharmacy. There was a statistically significant relationship between level of technology integration and the quantity of the types technology (indicated) ($F[4, 133] = 14.09$, $p \leq .001$) and the quantity of the types of technology (derived) ($F[4, 133] = 8.18$, $p \leq .001$). The quantity of the types of technology, both indicated and derived, had a general trend of increasing as the level of technology integration increased. In the quantity of the types of technology (indicated), an LSD post hoc test identified that the level of technology integration consisted of two groupings; the 0% to 50% integrated pharmacies had the fewest types of technology (indicated) and the 75% to 100% integrated pharmacies had the most ($p \leq .05$). The LSD post hoc test also identified two groupings of levels of technology integration for the quantity of the types of technology (derived); the 0% to 25% integrated pharmacies had the fewest types of technology (derived) and the 50% to 100% integrated pharmacies had the most ($p \leq .05$).

**Table 10.**

**Comparison of the quantity of the types of technology between the level of technology integration**

| | Level of Technology Integration | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0% Not at all | 25% Integrated | 50% Integrated | 75% Integrated | 100% Integrated | *df* | *F* |
| Quantity of Types of Technology (indicated) | $2.94_a$ (1.30) | $3.38_a$ (1.63) | $3.70_a$ (1.03) | $5.22_b$ (1.49) | $5.20_b$ (1.53) | 4, 133 | 14.09*** |
| Quantity of Types of Technology (derived) | $6.00_a$ (3.41) | $5.94_a$ (2.67) | $7.85_b$ (2.66) | $8.90_b$ (2.12) | $9.09_b$ (2.58) | 4, 133 | 8.18*** |

Note. *** = $p \leq .001$. Standard deviations appear in parentheses below means. Results of LSD post hoc paired comparisons are shown using subscripts (a, b). Means with the same subscript are not significantly different while means with different subscripts are significantly different from one another at the $p \leq .05$.

A paired samples *t*-test (results not shown in table) was used to compare the quantity of the types of technology (indicated) and the quantity of the types of technology (derived) variables. There was a difference in the means for the two different ways of measuring the quantity of the types of technology variable. The quantity of the types of technology (indicated) was significantly different ($M$ = 4.47, $SD$ = 1.69) from the quantity of the types of technology (derived) ($M$ = 8.08, $SD$ = 2.86); $t(141) = -20.94$, $p \leq 0.000$.

### 4.3.3 Relationships Between Workaround Use and Staff Characteristics

To evaluate the factors that are associated with the respondent's workaround use, the first analyses looked at variables pertaining to the staff characteristics. Pearson's contingency coefficients were calculated for the workaround use and the staff characteristics that were categorical data (results not shown in table). A statistically significant relationship was found between gender and workarounds use with bar code scanners during prescription filling ($C[98] = .312$, $p \leq .032$). This means that 9.7% of the variability in workaround use is explained by the variability of the respondent's gender. A Spearman correlation (results not shown in table) identified a significant relationship between the respondent's age and the workaround use with a company provided personal digital assistant ($\rho[16] = -.536$, $p \leq .032$) which means that 28.7% of their variance is shared and that as age increases, workaround use with company provided personal digital assistants decreases.

The workaround use with pharmacy management software was related to the respondent's job title ($C[120] = .429$, $p \leq .041$) and head/senior technician leadership ($C[32] = .501$, $p \leq .030$). This means that the variance in the respondent's job title accounted for 18.4% of the variance in workaround use and that the variance in head/senior technician leadership accounted for 25.1% of the variance in pharmacy management software workaround use. Further, a significant relationship was present between leadership experience as a head/senior technician and prescription scanner workaround use ($\rho[7] = -.896$, $p \leq .006$) indicating 80.3% shared variance and that as leadership experience as a head/senior technician increases, prescription scanner workaround use decreases. Additionally, Table 11 also shows that the amount of leadership experience as a senior technician was related to their perceived prescription scanner workaround use ($F[2, 4] = 85.02$, $p \leq .01$). Both the Spearman and ANOVA statistics had small samples but Table 11 indicates that, on average, the head/senior technicians with the most leadership experience indicated that they never used workarounds with their prescription scanner technology.

**Table 11.**

**Relationships between various factors and workaround use for specific technology**

**Prescription Input Technology**

| | Pharmacy Management Software Workaround Use | | | | | | |
|---|---|---|---|---|---|---|---|
| | Never | Infrequently | Frequently | Very Frequently | Every time | *df* | *F* |
| Quantity of Types of Technology (indicated) | $5.43_{a}$ (1.41) | $4.67_{ab}$ (1.64) | $4.32_{b}$ (1.89) | $4.25_{b}$ (1.55) | $3.40_{b}$ (1.14) | 4, 114 | 2.48* |

| | Electronic Prescribing Workaround Use | | | | | | |
|---|---|---|---|---|---|---|---|
| | Never | Infrequently | Frequently | Very Frequently | Every time | *df* | *F* |
| Quantity of Types of Technology (indicated) | $5.60_{a}$ (1.50) | $4.78_{b}$ (1.39) | $4.46_{b}$ (1.61) | $4.20_{b}$ (0.92) | $3.67_{b}$ (1.86) | 4, 94 | 3.79** |

| | Prescription Scanner Workaround Use | | | | | | |
|---|---|---|---|---|---|---|---|
| | Never | Infrequently | Frequently | Very Frequently | Every time | *df* | *F* |
| Head/senior Technician Leadership Experience | 11.50 (0.71) | 3.13 (0.85) | 1.00 (0) | 0 (0) | 0 (0) | 2, 4 | 85.02** |

| | Accessing the Internet Workaround Use | | | | | | |
|---|---|---|---|---|---|---|---|
| | Never | Infrequently | Frequently | Very Frequently | Every time | *df* | *F* |
| Quantity of Computers in Pharmacy | $6.20_{ace}$ (5.95) | $6.19_{a}$ (3.87) | $2.85_{bd}$ (0.69) | $3.88_{acd}$ (2.10) | $10.40_{e}$ (8.39) | 4, 104 | 3.21* |
| Quantity of Types of Technology (indicated) | $5.35_{a}$ (1.82) | $4.38_{b}$ (1.67) | $3.57_{b}$ (1.56) | $3.88_{b}$ (2.03) | $4.00_{ab}$ (1.00) | 4, 106 | 3.43* |

| | Fax Machine Workaround Use | | | | | | |
|---|---|---|---|---|---|---|---|
| | Never | Infrequently | Frequently | Very Frequently | Every time | *df* | *F* |
| Quantity of Computers in Pharmacy | $5.44_{ab}$ (5.06) | $5.86_{b}$ (3.89) | $3.35_{a}$ (1.27) | $3.57_{ab}$ (1.56) | $10.60_{c}$ (8.23) | 4, 127 | 3.78** |
| Quantity of Types of Technology (indicated) | $5.02_{a}$ (1.45) | $4.62_{ab}$ (1.81) | $3.94_{bc}$ (1.96) | $3.64_{bc}$ (1.34) | $3.80_{ac}$ (0.84) | 4, 129 | 2.87* |

| **Pharmacist Specific Technology** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Voicemail or Answering Machine Workaround Use | | | | | | |
| | Never | Infrequently | Frequently | Very Frequently | Every time | *df* | *F* |
| Quantity of Types of Technology (indicated) | $5.35_{a}$ (1.36) | $4.36_{b}$ (1.61) | $5.14_{ab}$ (1.77) | $4.20_{b}$ (0.79) | $3.50_{ab}$ (0.71) | 4, 102 | 3.64** |

Note. * = p ≤ .05, ** = p ≤ .01. Standard deviations appear in parentheses below means. Results of LSD post hoc paired comparisons are shown using subscripts (a, b, c, d, e). Means with the same subscript are not significantly different while means with different subscripts are significantly different from one another at the p ≤ .05.

The following comparison of the staff characteristics and the workaround use with prescription filling technology is not shown in a table. Leadership experience as the pharmacist-in-charge was significantly related to automated dispensing machine workaround use (ρ[11] = .634, $p \leq .036$) and unit dose packer/sealer workaround use (ρ[10] = .965, $p \leq .000$). The variance in leadership experience as the pharmacist-in-charge accounted for 40.2% of the variance in workaround use with dispensing machines and 93.1% of the variance in the workaround use with unit dose packer/sealer technology. And the trend is the same for both, as leadership experience as the pharmacist-in-charge increases, the workaround use for these types of technologies decreases individually.

### 4.3.4. Relationships Between Workaround Use and General Pharmacy and Technology Characteristics

There were only two statistically significant findings associated with workaround use and general pharmacy characteristics (not shown in table). The relationship between the respondent's practice setting and workaround use with pharmacy management software was significant ($C[119] = .467$, $p \leq .033$) and 21.8% of the variance in pharmacy management software workaround use is accounted for by the respondent's practice setting. Practice setting was also related to faxing workaround use ($C[134] = .470$, $p \leq .009$) and 22.1% of their variance was related.

A Kendall's tau-c was calculated between ordinal variables such as the pharmacy's daily prescription volume and level of technology integration and the workaround use with electronic prescribing (not shown in table). Daily prescription volume was significantly related to electronic prescribing workaround use, $\tau(100) = -.176$, $p \leq .014$. This indicates that 3.1% of their variance is related and that as prescription volume increases, electronic prescribing workaround use decreases slightly. The level of technology integration was significantly related to several different technologies' workaround use.

Level of technology integration was related to pharmacy management software workaround use ($\tau[116] = -.221$, $p \leq .001$), workaround use with electronic prescribing technology ($\tau[96] = -.199$, $p \leq .014$), workaround use with accessing the Internet ($\tau[107] = -.225$, $p \leq .001$), and workaround use during faxing ($\tau[130] = -.236$, $p \leq .001$). This indicates that the variance in the pharmacy's level of technology integration accounts for 4.9% of the variance in pharmacy management workaround use, 4% of the variance in electronic prescribing workaround use, 5.1% of the variance in accessing the Internet workaround use, and 5.6% of the variance in faxing workaround use. It also shows a statistically significant trend that, as the level of technology increases, these technologies' workaround use decreases.

Table 11 also displays the relationships between workaround use with the different types of technology and the quantity of computers in the pharmacy. A significant finding was identified between the quantity of computers in the pharmacy and workaround use accessing the Internet ($F[4, 104] = 3.21$, $p \leq .05$) and fax machine workaround use ($F[4, 127] = 3.78$, $p \leq .01$). There is not an easily identifiable general pattern of the means with the LSD post hoc tests, but in both the accessing the Internet workaround use and fax workaround use the respondents with the fewest computers in the pharmacy indicated workaround use "frequently" with those technologies. Also, respondents with the highest quantity of computers in the pharmacy indicated that they used workarounds "every time" they used the technologies. Another similarity between the two technologies was that those respondents that were approximately in the middle range of the quantity of computers in the pharmacy indicated that they were in the lowest frequency categories of workaround use for both technologies.

A Spearman correlation was calculated for the quantity of the types of technology (indicated and derived) and the various types of technology workaround use (not shown in table). The quantity of the types of technology (indicated) was significantly related to the workaround use with the pharmacy management software ($\rho[119] = -.291$, $p \leq .001$), electronic prescribing ($\rho[99] = -$

.395, $p \leq .000$), accessing the Internet ($\rho[111] = -.337$, $p \leq .000$), faxes ($\rho[134] = -.291$, $p \leq .001$), and voicemail ($\rho[107] = -.305$, $p \leq .001$). This shows a correlation of the workaround use with each of the above mentioned, type of technology, with the quantity of the types of technology (indicated) in which 8.5%, 15.6%, 11.4%, 8.5%, and 9.3% of the variability of the workaround use with management software, electronic prescribing, faxes, and voicemail, respectively, is attributed to the variability of the quantity of types of technology (indicated). All of these correlations suggest that as the quantity of technologies in a pharmacy increases, the workaround use with each of these types of technology decreases individually.

A Spearman correlation was also calculated for the quantity of types of technology (derived) with similar results to those above (not shown in table). The quantity of the types of technology (derived) was related to pharmacy management software workaround use ($\rho[120] = -.215$, $p \leq .018$), electronic prescribing workaround use ($\rho[100] = -.224$, $p \leq .025$), and workaround use accessing the Internet ($\rho[112] = -.250$, $p \leq .008$). In this analysis there was no significant relationship with fax workaround use ($\rho[135] = -.153$, $p \leq .076$) or voicemail workaround use ($\rho[108] = -.114$, $p \leq .241$). However, the same trend is present, as the quantity of the types of technology (derived) increases, the workaround use with each of these types of technology decreases individually.

Further, Table 11 shows the comparison between the workaround use with the different types of technology and the quantity of the types of technology (indicated). The quantity of the types of technology (indicated) was related to the pharmacy management software workaround use ($F[4, 114] = 2.48$, $p \leq .05$), electronic prescribing workaround use ($F[4, 94] = 3.79$, $p \leq .01$), accessing the Internet workaround use ($F[4, 106] = 3.43$, $p \leq .05$), fax workaround use ($F[4, 129] = 2.87$, $p \leq .05$), and voicemail workaround use ($F[4, 102] = 3.64$, $p \leq .01$). The general trend in the workaround use with pharmacy management software was that it decreased as the quantity of the types of technology (indicated) increased. This same trend is present in the workaround use with electronic prescribing with the addition of two groupings being identifiable; those pharmacies with the most types of technology (indicated), on average, “never” use workarounds with their electronic prescribing technology and the remaining workaround use categories can be collapsed into one inclusive category based upon the LSD post hoc test ($p \leq .05$). The fax workaround use is almost consistent with the general trend of an increase in the quantity of the types of technology (indicated) with a decrease in the fax workaround use. There are no easily identifiable trends with the workaround use accessing the Internet or voicemail; however as above, those pharmacies with the most types of technology (indicated), on average, “never” use workarounds to access the Internet.

## 4.4. Cluster Analyses

This section describes the analysis that was used to answer the research question:

> What are the identifiable subgroups of respondents that differ in the use of workarounds?

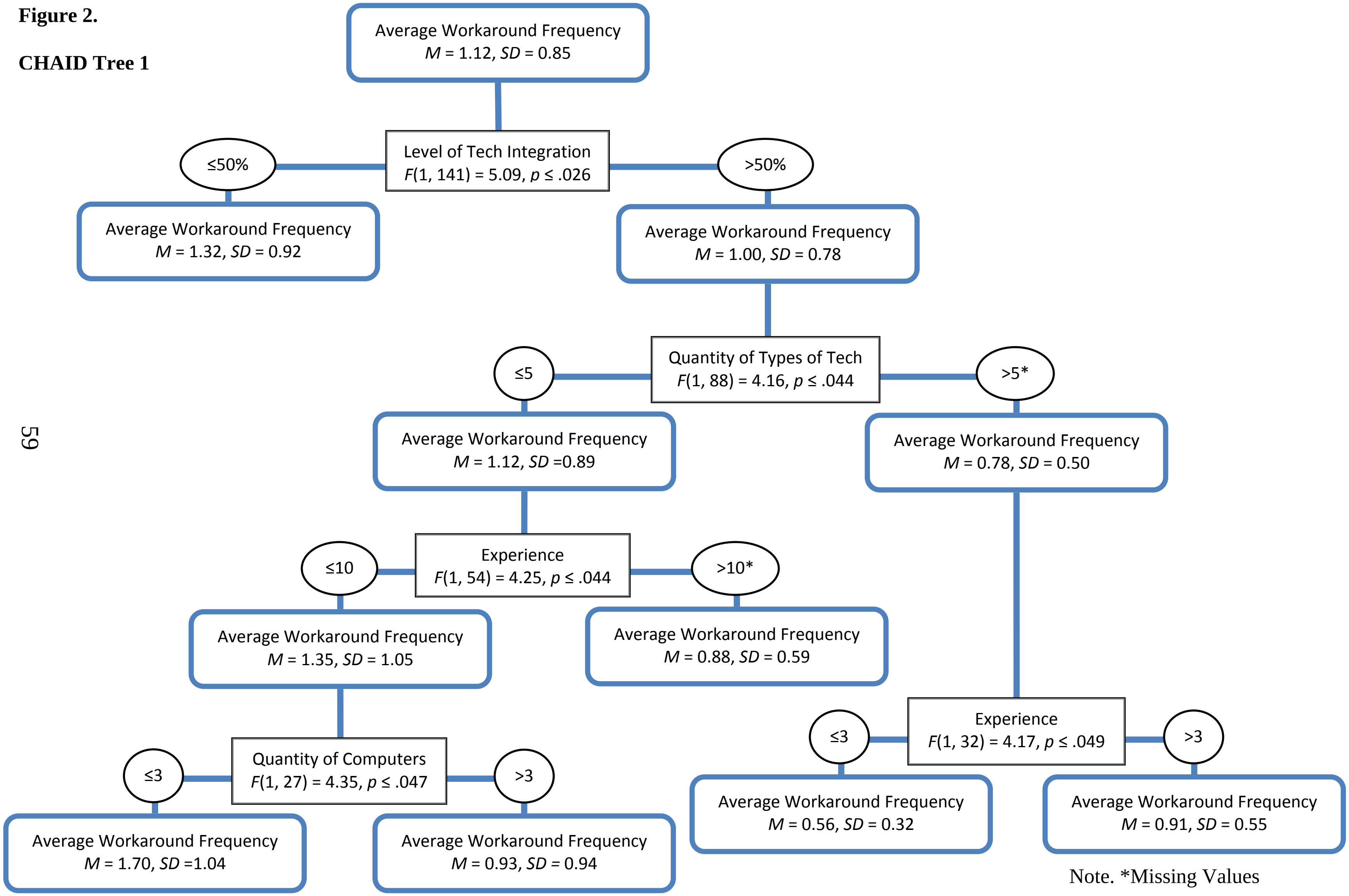
An average workaround frequency variable was created by summing the numerical coding of the ordinal variables of workaround use for each type of technology and then dividing that value by the quantity of the types of technology (derived) for each respondent. The average workaround frequency variable was used in a cluster analysis (Chi-squared Automatic Interaction Detector) to distinguish between mutually exclusive characteristics of the staff, general pharmacy, and technology. The alpha level for this analysis was set to 0.05. There are two tree diagrams that are presented in this text. Given the exploratory nature of this study, it was important to cover any results that seemed plausible.

### 4.4.1. CHAID Tree 1 (Figure 2)

In the first tree (see Figure 2), level of technology integration is the first level of clustering ($F[1, 141] = 5.09$, $p \leq .026$). At this level, pharmacies that were less than 50% integrated are differentiated from those that are greater than 50% integrated. The greater than 50% integrated cluster has the lower average workaround frequency ($M = 1.00$, $SD = 0.78$) as compared to the less than 50% integrated cluster ($M = 1.32$, $SD = 0.92$). The less than 50% integrated cluster was not further differentiated beyond this level.

**Figure 2.**

**CHAID Tree 1**




Note. *Missing Values

The second layer of clustering for this tree was based on the quantity of the types of technology (indicated) in the pharmacy and was applied only to the greater than 50% integrated cluster ($F[1, 88] = 4.16$, $p \leq .044$). The resulting clusters are ‘less than or equal to five’ and ‘greater than five and missing value’. The ‘greater than five and missing value’ cluster had a lower average workaround frequency ($M = 0.78$, $SD = 0.50$) than the ‘less than or equal to five’ cluster ($M = 1.12$, $SD = 0.89$).

The third layer of clustering for this tree was based on experience and was applied to both of the above clusters. In the ‘less than or equal to five’ cluster for the quantity of the types of technology (indicated) in the pharmacy, experience was differentiated into two clusters; ‘less than or equal to 10 years’ and ‘greater than 10 years and missing value’ ($F[1, 54] = 4.25$, $p \leq .044$). The ‘greater than 10 years and missing’ cluster had the lower average workaround frequency ($M = 0.88$, $SD = 0.59$) compared to the other cluster ($M = 1.35$, $SD = 1.05$). The ‘greater than 10 years and missing’ cluster was not further differentiated beyond this level.



60

In the ‘greater than five and missing value’ cluster for the quantity of the types of technology (indicated) in the pharmacy, experience was differentiated into two clusters; ‘less than or equal to three years’ and ‘greater than three years’ ($F$[1, 32] = 4.17, $p \leq .049$). The less than or equal to three years cluster had the lower average workaround frequency ($M$ = 0.56, $SD$ = 0.32) compared to the ‘greater than three years’ cluster ($M$ = 0.91, $SD$ = 0.55). This branch of the tree was not further differentiated beyond this level.

The last level of this tree was based on the quantity of computers in the pharmacy and was applied to the ‘less than or equal to 10 years’ cluster of experience. This resulted in two differentiated clusters; ‘less than or equal to three’ and ‘greater than three’ ($F$[1, 27] = 4.35, $p \leq .047$). The ‘greater than three’ computers in the pharmacy cluster had the lower average workaround frequency ($M$ = 0.93, $SD$ = 0.94) compared to the less than or equal to three’ cluster ($M$ = 1.70, $SD$ = 1.04).

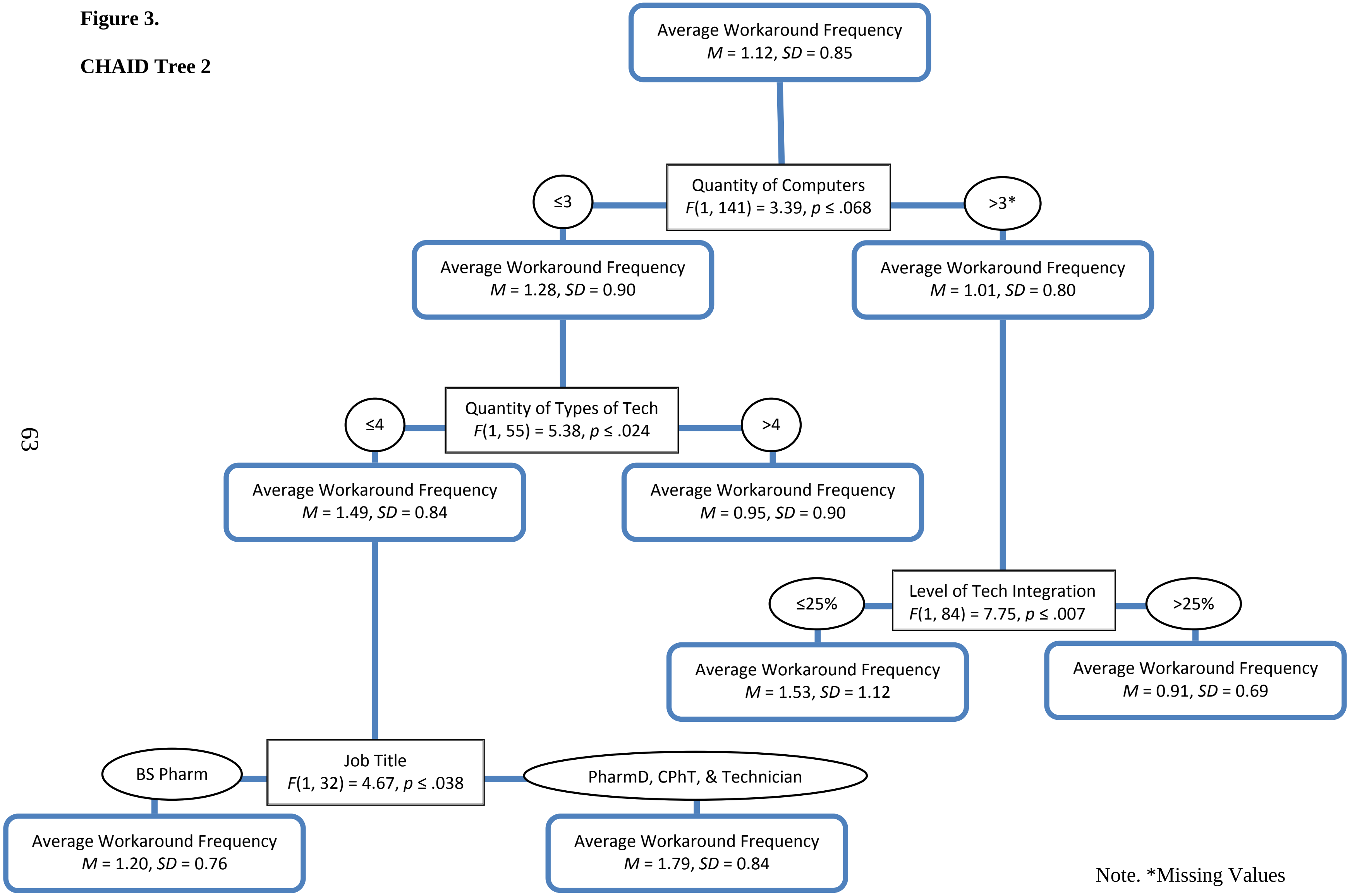
Based on Figure 2, those with the highest means of workaround use were those who had more experience and worked in pharmacies with a greater number of computers, had less than 5 types of technologies and had a greater level of technology integration. In contrast, respondents with the lowest means of workaround use were those who worked in pharmacies with a greater level of technology integration, greater than five types of technologies and had less experience.

#### 4.4.2. CHAID Tree 2 (Figure 3)

In the second tree (see Figure 3), the first layer of clustering is based on the quantity of computers in the pharmacy ($F[1, 141] = 3.39$, $p \leq .068$). At this layer of clustering, pharmacies with ‘less than or equal to three’ computers in the pharmacy are differentiated from those with ‘greater than three or missing value’. The ‘greater than three or missing value’ cluster has the lower average workaround frequency ($M = 1.01$, $SD = 0.80$) compared to the ‘less than or equal to three’ computers in the pharmacy cluster ($M = 1.28$, $SD = 0.90$).

**Figure 3.**

**CHAID Tree 2**




Note. *Missing Values

The 'greater than three or missing value' cluster is further differentiated in to two clusters based on level of technology integration ($F[1, 84] = 7.75$, $p \leq .007$). The 'greater than 25% integrated' cluster had the lower average workaround frequency ($M = 0.91$, $SD = 0.69$) compared to the 'less than or equal to 25% integrated' cluster ($M = 1.53$, $SD = 1.12$). This branch is not further differentiated beyond this level.

The 'less than or equal to three' computers in the pharmacy cluster from the first level is further differentiated based on the quantity of the types of technology (indicated) in the pharmacy ($F[1, 55] = 5.38$, $p \leq .024$). The 'greater than four' cluster has the lower average workaround frequency ($M = 0.95$, $SD = 0.90$) compared to the 'less than or equal to four' cluster ($M = 1.49$, $SD = 0.84$). The 'greater than four' computers in the pharmacy cluster is not further differentiated beyond this level.

In the last level of this tree the 'less than or equal to four' computers in the pharmacy cluster is differentiated into two clusters based on the respondent's job title ($F[1, 32] = 4.67$, $p \leq .038$). The respondents with the title BS Pharm are differentiated into a separate cluster from all of the other job titles in another cluster. The BS Pharm cluster had the lower average workaround frequency ($M = 1.20$, $SD = 0.76$) compared to the cluster of PharmDs, certified pharmacy technicians, and basic pharmacy technicians ($M = 1.79$, $SD = 0.84$). There were no further cluster differentiations beyond this level for this tree.

### 4.4.3. Cluster Analysis Summary

The results of these CHAID tree analyses illustrate that there were statistically distinct groups of respondents based upon their reported average frequency of workarounds. Generally speaking, staff characteristics and the technology characteristics were the predictor variables that differentiated the respondents into their respective groups.

## 4.5. Qualitative Results

The questionnaire allowed respondents to free text any additional information about workarounds that they wished to convey immediately following each section of the workaround use matrices for prescription input technology, prescription filling technology, and pharmacist specific technology. There were 18 respondents who entered free text about workaround use with prescription input technology, 10 respondents who entered free text about workaround use with prescription filling technology, and nine respondents who entered free text about workaround use with pharmacist specific technology. The responses have been grouped into categories:

A. Deliberately entering incorrect or misidentified data in order to proceed through a workflow process.

   1. Various examples of this workaround were mentioned by respondents. Phoned in prescriptions for patients with limited or no accompanying information were entered by inputting fictitious patient names, birth dates, and/or the ordering prescriber. This information was later corrected by the staff once the patient (or

their agent) came to claim the medication and provided the missing or incorrectly entered workaround information.

2. Respondents stated workarounds which involved entering patient information into the wrong fields. Such examples were free texting allergies that were not available in the system into the "patient comments" field and entering patient comments into the "patient address" field for those systems that do not have a designated area for such comments.

3. It was claimed that a system required workarounds due to some medication manufactures not being recognized by the system. A recognized manufacturer was entered into the system as the one dispensed despite giving the unrecognized manufacturer to patients. Similarly, when a prescription was partially filled and the remaining medication was dispensed from a different manufacturer the ability to record this change in manufacturer was worked around in the system. This required the staff to hand write on the patient's medication label that the medication would look different than the previously dispensed partial or short filled medication.

4. One workaround involved a staff member having to change their job title in the system to the pharmacist-in-charge in order to perform certain functions such as merging patient profiles. The staff member subsequently changed their status back to their correct job title designation upon completion of the profile merge task.

B. Workarounds due to re-imbursement issues.

1. Workarounds were listed by several respondents as being needed in order to address issues pertaining to, in general, accounts/receivables, prescription insurances, and specifically some Medicare Part D claims. None of these workarounds were explained in detail as to what was done or why it was necessary.

2. There was an instance in which a workaround was required in order to adjust for the results of another workaround. When a dispensed medication was lost, a duplicate order was entered on the patient's profile to obtain another label to re-dispense the medication. This action caused the patient to be charged for the medication a second time which then required the staff member to manually enter a credit to the patient's account.

3. A workaround for partially filled prescriptions that were paid for by a third party involved the staff noting on a patient's bag that additional medication was "owed" to them due to the pharmacy's short supply despite the system generated label and patient's profile indicating that all of the medication was dispensed at the first filling.

C. Other workarounds due to perceived policy, system, or workflow inadequacies.

1. Official procedures were relaxed in specific circumstances such as one pharmacy's policy of not allowing verbal orders for dispensing. This policy was not followed during times of emergency such as in code situations.

2. Some workarounds of omission resulted from the lack of a method to require a specific workflow step or process. Policy requiring two staff members to verify all medications (a technician and a pharmacist) was not followed. It was stated that stickers or hand written notes were affixed to patient's bags "alerting staff" that a pharmacist needed to speak with the patient before releasing the medication to them. Along this same concept, carts filled with medications to be delivered to a hospital's ward were not always checked by a pharmacist.

3. There was a respondent who indicated that their system conducted drug interaction screening at order entry even if it was a technician as the order entering party. Ordinarily the prescription would be held up at order entry in the event of a drug interaction until a pharmacist could review it. The workaround involved technicians who knew the override codes (which were not person specific) and entered them when the interaction was not considered important to them.

4. When bar code scanners could not read the bar code of a medication the bar code of another package (or shelf affixed label) of the same medication was scanned in order to proceed through that workflow step. Further, another unreadable bar code workaround involved a technician sending the stock bottle to the pharmacist with the filled prescription who then overrode the filling bar code scanner step during prescription verification. It was also stated that pharmacists routinely overrode filling bar code scanning omissions at the verification step of the workflow process.

5. There were several responses about automated counters and dispensing robots requiring workarounds to compensate for under and over fills. Controlled medications that were electronically counted or dispensed by robots were said to be verified by a hand

count and some stated that controlled medications were only hand counted due to frequent miscounts by the machines. An accompanying workaround was claimed by one respondent, that in the event of a robot overfill the extra medication was "put aside" until the robot was restocked by a staff member.

6. When the system was unable to identify a patient's unknown medication, the pharmacy would give the patient the phone number to Poison Control for the patient to call for further assistance.

7. There was a workaround described that had legal ramifications based upon the Alabama regulation of pharmacy practice. In Alabama, only a state registered, licensed pharmacist or pharmacy intern can reduce a verbal medication order into a written prescription. The workaround described indicated that senior technicians would take prescriber phoned in prescriptions, check the pharmacy voicemail, and reduce those communication to written prescriptions only when the pharmacist was very busy or had stepped out of the pharmacy.

D. Miscellaneous workarounds.

1. Workstation passwords were posted in the pharmacy or at the particular workstation.

2. A patient's previously dispensed medication order was re-dispensed when a prescriber did not respond to the pharmacy's

call, fax, and/or email for a refill authorization or order clarification (poor handwriting). Also, it was stated that new medications were sometimes dispensed after speaking with the patient about what the prescriber was ordering despite the pharmacy not being able to clarify the order with the prescriber.

3. When a late shift pharmacist is given an order for an antibiotic to be “dosed and followed-up”, they only enter a single dose and defer the order management to the daytime staff.

## Chapter 5: DISCUSSION

This study helps to bring together the generalizations of Kobayashi et al. (2005) who proposed that the key features of workarounds were staff characteristics (person's role, knowledge of others' abilities, favors owed, etc.) and Vogelsmeier et al. (2008) who identified the main causes of workarounds as "due to technological design". The results echoed several of the findings of earlier work published on workarounds. The free text entered by respondents agreed with Kobayashi et al.'s (2005) claim of the potential cascading effect of workarounds in which the use of one can cause the need for the use of additional workarounds as a byproduct of the first (see 4.5.B.2.). They also illustrated Poelman's (1999) concept of workflow viscosity leading to a workaround (see 4.5.C.7.). The free text workarounds fitted with the model proposed by Ferneley and Sobreperez (2006) that included the essential, hindrance, and harmless workaround categories. The free text workarounds were also consistent with the expectation that the level of resistance behavior, positive versus negative, of the hindrance and harmless workarounds were debatable and highly dependent upon the vantage point of the evaluator.

The results of this study suggest that many variables were related to the workaround use in pharmacies. This discussion classified these variables into three groups: staff characteristics, general pharmacy characteristics, and the pharmacy technology characteristics. Examples of staff characteristics were gender, age, job title, experience, etc. General pharmacy characteristics included practice setting and daily prescription volume. Pharmacy technology characteristics were level of technology integration, quantity of the types of technology (derived and indicated) in the pharmacy, and the quantity of computers in the pharmacy. Based upon the results of the analyses, staff characteristics and the pharmacy technology characteristics were associated with workaround use more often than when compared to the general pharmacy characteristics such as practice setting and daily prescription volume. It is worth noting that general pharmacy characteristics were not significant predictor variables in the two CHAID trees (see Figures 2 and 3).

The cluster analysis added even more evidence to the proposition that staff characteristics and pharmacy technology characteristics were important factors in the use of workarounds in pharmacies. They were the only statistically significant predictor variables produced by the CHAID trees (see Figures 2 and 3). Out of these two categories, pharmacy technology had the most impact with all of the technology variables being present in both CHAID trees (see Figures 2 and 3). The first CHAID tree presented appeared to be the most intuitive in its presentation. Overall the pharmacies with a lower level of technology integration used, on average, more workarounds than those with a higher level of integration. It is possible to further differentiate groups in regards to workaround use within the highly integrated pharmacies. In highly integrated pharmacies, having many different types of technology was associated with a lower reported frequency of workarounds.

Experience also seems to have played a role in workaround use. Specifically, in pharmacies with many different types of technology, staff with more experience reported more use of workarounds. This may have been due to the need for a user to have more experience and/or in-depth knowledge of a complex system before they are comfortable or insightful enough to use a workaround. A complex system would be one which is highly integrated with many types of technology.

This finding of increased experience being associated with the increased use of workarounds was not consistent in all pharmacies. It is in contrast to the results from those pharmacies which had fewer types of technology where the less experienced users were the ones who reported more workaround use. In this case it could be argued that the less experienced users may not have been as intimidated by a less complex system and thus were able to exploit system vulnerabilities more readily and more frequently than a more experienced user would. This is further supported by the finding that the group of less experienced users was further differentiated by the quantity of computers in their pharmacy and the less complex system, those with less than or equal to three computers, reported almost twice the average number of workarounds versus the pharmacies with more than three computers.

This same trend was present in the second CHAID tree presented (see Figure 3). More complex systems, those with a greater level of technology integration, more computers in the pharmacy, and more different types of technology had, on average, fewer workarounds reported. In the simple system branch the BS Pharm staff reported the lowest frequency of workarounds. This is consistent with this discussion that more experienced staff with less complex systems reported workaround use than the less experienced staff. The BS Pharm degree is no longer the entry level degree for new pharmacists, which suggests that this group of practitioners were older and thus have been in practice longer. This argument was supported further by the respondents' job title and experience characteristic Analysis of Variance which showed that the BS Pharm respondents had more experience than the other groups (see Table 7).

The results of this study can have an immediate impact for practitioners who are about to implement, upgrade, or modify an existing pharmacy system due to the findings of the relationships between technology and workaround use. It is still unknown whether the use of workarounds can cause errors; and until then those attributes that appear to be associated with fewer workarounds should be considered during the search for a new system or when considering a current system upgrade. It would be wise to consider a system that is highly integrated with multiple different types of technology available to the pharmacy staff for prescription processing. Plus, given the additional results of the less experienced users reporting fewer workarounds with systems with a high level of integration, this recommendation could benefit a pharmacy which has a high employee turnover rate or a staff with low work experience on average. Lastly, the developers who produce these products and systems can also follow this recommendation by using common system interfacing standards so that their products can be more readily integrated with other products and systems.

Despite a lack of strong inferential statistics relating to a cause and effect relationship between workarounds and patient safety, this study has illuminated some of the risks to patient safety based upon specific workarounds reported in the free text responses. Reports of potentially fraudulent insurance billing practices and illegal workflow practices in which non-pharmacist staff performed pharmacist specific functions such as taking medication orders and overriding drug interactions is troublesome. In addition to these reports, risky practices such as entering incorrect information into patient profile fields could lead to dispensing errors as mild as missed customer service opportunities to potentially grave mistakes in which a decision support system may have made a difference given the opportunity to screen medications against correctly entered information. Based upon the potential safety risk implied by some of the free text workaround examples detailed by the respondents in this study, it is important that serious consideration be given to the risks and benefits of using a workaround. What may seem to be a wonderful quick fix for the immediate obstacle may actually do more harm than good.

**5.1. Limitations**

This study had several limitations that need to be addressed. The study sample was geographically focused within the state of Alabama. This may limit the generalizablility of the results to pharmacies in other states. One key reason for this limitation is that pharmacy law varies between states. For example, the workaround reported of a technician reducing voicemail prescriptions to writing in the Alabama survey would be a legally acceptable workflow practice in states that permit these actions if that pharmacy also allowed such practices. The next limitation is related to the low response rate of 25.5%. This low response rate was possibly due to the enrollment and participation period including major holidays such as Christmas, Hanukkah, and New Year's Day. Despite the use of random sampling, the lack of participation by non-responders may have biased the sample in ways that are not readily evident.

The methodology chosen for this study also carried with it inherent limitations. The survey study design did not afford the ability to determine a cause and effect relationship amongst the variables. Statistical tests were run to determine the strength of associations and the cluster analyses suggested groupings of variables associated with workarounds; however, solid experimental inferences were not possible. Also, this study's questionnaire required several important assumptions of the respondent's knowledge about the subject matter. Respondents were expected to know their specific organization's workflow and their pharmacy's workaround use.

This expected respondent knowledge brings more of the inherent study design flaws back into the picture since this implies that respondents recalled the use of workarounds while answering the questionnaire. Moreover, respondents were expected to be truthful in their responses which may indicate the use of fraudulent or illegal practices. However, it is expected that this problem is minimal due to the nature of anonymity of this study's methodology. However, this incentive introduced the assumption that respondents only completed the questionnaire a single time. It is possible that respondents answered the questionnaire multiple times since they were mailed complete questionnaires twice and given the URL to the online version of the questionnaire in all four requests for study participation.

There were some issues with the wording of some questions that were not evident from the pilot but that surfaced during the study. Originally the questions pertaining to the “additional technological functionality” (see Table 3) were to be used in conjunction with the indicated quantity of types of technology (see Table 3) in relation to the workaround use reported. However, the data were often contradictory by respondents and thus the decision was made to exclude them from the analyses due to validity concerns. For example, it was quite common for respondents to indicate that they did not have access to the Internet or an intranet but then later stated that they did access to have online resources. Another example, several times respondents indicated that they did not have a personal or company provided personal digital assistant (PDA) but later indicated workaround use for the PDA. This inconsistency in responses led to the calculation of the derived quantity of types of technology and later used it to calculate the average workaround frequency. It is important to note that both measures (derived quantity of types of technology and indicated quantity of types of technology) produced statistically significant results and given the exploratory nature of this study, both were reported.

Both of these measurements have validity concerns for different reasons. The indicated quantity of types of technology variable is obviously an underestimation since several items were discarded due to erroneous responses. Also, the derived quantity of types of technology variable is possibly over estimated given the confusion illustrated by the responses pertaining to items such as online resources and PDAs. However, despite the potential short comings of these variables, they do help to glean some light on the intended target of measurement, a quantity of different types of technology available in the pharmacy to the respondents.

Lastly, the questionnaire (see Appendix A) made reference to electronic prescribing technology by the abbreviation eRx. This abbreviation was later, subsequent to the distribution of the survey, found to be the actual trade name of a healthcare technology product. It is unknown whether this affected the results of the responses to those items.

**5.2. Suggestions for Future Research**

Other studies are needed to extend this study. For example, a similar study conducted in multiple states would improve the generalizability of the findings. Also, studies that use randomized observation and interview methodology may be able to yield additional meaningful associations between workarounds and variables that are difficult to assess through a survey. Further, since an observation method does not rely on respondents' self-report, it may be able to obtain accurate data such as workaround use and availability of technology.

Several explanatory studies examining the effect of workarounds on errors could be invaluable to the pharmacy profession. A study to determine if there is a link between workarounds and dispensing errors could help developers in future pharmacy system design. If there is a link, future research should investigate whether it extends beyond the specific workaround action and relates to a broad category of workarounds. In addition to this, are workarounds and/or their link to errors associated with a particular technological system design, safety control processes, or administrative data gathering processes? To test the claim that healthcare practitioners operate in a “get it done” fashion, these studies could add the documentation of the motivation of the users for performing workarounds.

These examinations of workaround effects should also be conducted in other healthcare fields. Workarounds have been mentioned in healthcare several times, but there are few properly designed studies to determine their true causes let alone attempt to decrease practitioners’ reliance upon them. Studying workarounds in a formal manner could reap huge dividends for all parties involved. System designers could potentially produce systems which are safer, more efficient, and have a higher user satisfaction. Users would be in a position to better understand the benefits and risks associated with using workarounds in specific situations. Possibly, it could be determined whether or not planning for and including workarounds in a system’s design is beneficial. These resulting systems could be set up to detect, monitor, and/or prevent certain workarounds from being used.

The field of workaround research is still in its infancy. Researchers have acknowledged the presence of this phenomenon in several healthcare disciplines. The work that must be done now is to understand workarounds better so that practitioners can guarantee safety to their patients, improve the efficiency of their businesses, and enhance the working conditions of our system users.

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## APPENDIX A. Survey Packet

# Prescription Preparation Workarounds

## Introduction

Hello,
Thank you for taking the time to complete this survey. I am a licensed pharmacist in the State of Alabama and this project is being conducted in order to complete the requirements for graduation with a Master of Science Degree in Healthcare Informatics from Auburn University's Harrison School of Pharmacy with the cooperation of Alabama State Board of Pharmacy.

After speaking with many of you personally, it seems that despite the many different pharmacy systems in use, many have the same shortcomings. With your help we can better understand the workaround phenomenon and help pharmacy system developers and safety advocates produce better systems for our pharmacies. As a practicing pharmacist myself, I realize the impact that the use of workarounds can have on the processes intended to protect our patients, document our actions, and ensure accurate reimbursement for services rendered.

The potential benefits of this study are that it may illustrate that workarounds exist in pharmacies that prepare prescriptions and that other pharmacies should expect to encounter them. In addition, specific contributing factors that affect the use of workarounds may be identified. This information may later be used by developers to improve our systems to better serve and protect our patients.

Later research could use the pharmacy workaround phenomenon identified by this study to develop descriptive and explanatory studies to examine:
a. Types of errors associated with each workaround.
b. If a particular workaround is beneficial, detrimental, or innocuous to the system.
c. How workarounds affect other healthcare settings such as hospitals, nursing homes, home healthcare, etc.

Thank you in advance for taking the time to complete this survey.

Wes Wilkerson, PharmD.

Page 1

# Prescription Preparation Workarounds

## Study Information Letter & Consent

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HARRISON SCHOOL
OF PHARMACY

"The Auburn University
Institutional Review Board
has approved this document for use
From August 25, 2008 to August 24, 2009.
Protocol #08-208 EX 0808."

INFORMATION LETTER
for a Research Study entitled
"An Exploratory Study of the Perceived Use of Workarounds During the Prescription Preparation Process of Pharmacies in Alabama"

You are invited to participate in a research study to describe workarounds associated with prescription preparation in a pharmacy setting. The purpose of this study is to determine if workarounds are being utilized during prescription preparation in Alabama pharmacies. If so, are they associated with the pharmacy practice setting, prescription preparation volume, quantity, and/or type of pharmacy technology used? This research also seeks to evaluate and compare the categorization of workarounds proposed by Petrides (2004) and Ferneley (2006) and to potentially propose a definition and/or classification scheme of workarounds for the pharmacy setting.

The study is being conducted by Thomas Wesley Wilkerson, PharmD., under the direction of Bill G. Felkey, M.S. in the Auburn University Department of Pharmacy Care Systems. You were selected as a possible participant because you are registered with the Alabama Board of Pharmacy as either a pharmacy technician or pharmacist and are age 19 or older.

What will be involved if you participate? If you decide to participate in this research study, you will be asked to complete a questionnaire, either online or paper based, about the use of workarounds you may have used while preparing prescriptions at your pharmacy. You may respond using the enclosed paper copy questionnaire and returning it via the pre-addressed return envelope or by completing the online version located at http://pharmacy.auburn.edu/survey

Page 2

## Prescription Preparation Workarounds

### Study Information Letter & Consent

Are there any risks or discomforts? There are no anticipated risks to you expected as a result of participating in this research. The online questionnaire host, surveymonkey.com, will not collect respondents e-mail addresses or IP addresses. It will not be possible for the researchers to identify individual respondents or the specific organizations which they work for based upon their answers to the questionnaire. We do not need to know who you are, where you work or whether you chose to respond or not.

You may be uncomfortable answering questions pertaining to the use of pharmacy workarounds since they can have legal ramifications such as fraudulent billing practices, drug diversion, and patient safety concerns. However, despite this potential discomfort, the study procedures do not provide for any way that any information can be linked to you or your organization.

Are there any costs? If you decide to participate, you will not incur any financial costs.

If you change your mind about participating, you can stop answering the questions on the questionnaire at any time. If you are responding via the online version closing the browser will end your questionnaire session. Your participation is completely voluntary. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with the Auburn University Harrison School of Pharmacy or the Alabama Board of Pharmacy.

Your privacy will be protected. All information gathered from the questionnaires will be anonymous, meaning that there are no codes or other identifying information linking them to individual respondents. Information obtained through your participation will be used collectively to prepare a thesis to fulfill an educational degree requirement.

Please DO NOT sign any form that you send to the researchers and DO NOT include a return address. There will be no information linking you to participation in this study in an effort to ensure the anonymity of all respondents.

If you have questions about this study, please ask them now; contact Thomas "Wes" Wilkerson at wilketw@auburn.edu or 334-750-3893 or contact Bill G. Felkey at felkebg@auburn.edu or 334-844-8360.

If you have questions about your rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

If you decide to participate, the data you provide indicates your willingness to do so.

PLEASE RETAIN THIS COPY FOR YOUR RECORDS.

Thank You,

Thomas Wesley Wilkerson, PharmD.
Principle Investigator

Bill G. Felkey, M.S.
Research Advisor

*** 1. To continue, select the appropriate option below and then click the "next" button. To stop at any time, just close your browser window. You may print a copy of this letter to keep.**

◯ I am over the age of 19 and I would like to participate in this study.

◯ I am NOT over the age of 19 or I choose NOT to participate in this study.

# Prescription Preparation Workarounds

## Instructions to Complete Questionnaire

**WORKAROUND is defined as any workflow action that is not included as part of the official pharmacy prescription preparation process workflow.**

WORKAROUND is defined as any workflow action that is not included as part of the official pharmacy prescription preparation process workflow.

Workarounds are the informal practices that are used when the organization's stated "correct" way is not the method or step that is used. Examples of workarounds: 1) Use of a workaround could be employed in situations of a failed system component such as a bad label printer in which the user must now hand record all the legal dispensing information on the back of a prescription. 2) Another workaround may be that the login name and password of a specific workstation is affixed to the bottom of the keyboard since users often cannot remember it possibly due to the password's complexity, requirement of a different password per workstation, or the frequency of password change.

This study explores your knowledge of workarounds that are possibly being utilized while using many types of technology found in our pharmacies. As you read through the survey, please answer each question as accurately as possible. Your response to the questionnaire is entirely voluntary and anonymous. No identifying information will be asked and the questionnaire is NOT in any way coded, numbered, or marked to identify the origin of the respondents.

Page 4

# Prescription Preparation Workarounds

## Demographics

**2. What is your gender?**

◯ Female

◯ Male

**3. What is your age in years?**

**4. Which of the following best describes your pharmacy job title? *Check Only One***

◯ Nationally Certified Pharmacy Technician (CPhT)

◯ Pharmacist (BS Pharm)

◯ Pharmacist (PharmD)

◯ Pharmacy Technician

◯ Other (please specify)

**5. How many years have you had your current pharmacy job title?**

**6. Are you the legal "pharmacist in charge" at your current pharmacy?**

◯ N/A - I am not a pharmacist

◯ No

◯ Yes - How many years with this specific designation?

**7. Are you the recognized "head" or "senior" pharmacy technician at your pharmacy?**

◯ No

◯ N/A - I am not a pharmacy technician

◯ Yes - How many years with this specific designation?

**8. Which of the following best describes your primary pharmacy practice setting?**

- ◯ Corporate Owned Community
- ◯ Hospital - Outpatient
- ◯ Mail Order
- ◯ Independently Owned Community
- ◯ Hospital - Inpatient
- ◯ Other (please specify)

*** 9. Do you fill, prepare, or dispense prescriptions or medication orders as part of the normal workflow process of your current pharmacy practice setting?**

- ◯ No
- ◯ Yes

## Prescription Preparation Workarounds

### Demographics

**10. How many prescriptions or medication orders does your pharmacy fill, dispense, or prepare on average DAILY?**

- ◯ <50
- ◯ 51-100
- ◯ 101-200
- ◯ 201-300
- ◯ 301-400
- ◯ 401-500
- ◯ 501-1000
- ◯ 1001-1500
- ◯ 1501-2000
- ◯ 2001 or more

**11. Does your pharmacy management software (HCC, InterCom Plus, PharmacyRx, PharmNet, QS/1, Rx2000, Rx30, etc.) allow you to access a patient's medication profile if it is located at another site or pharmacy (commonly referred to as a remote or central profile)?**

- ◯ No
- ◯ Not Sure
- ◯ Yes
- ◯ Other (please explain)

**12. Do you have access to the internet or an intranet from any of the pharmacy department's computer terminals?**

- ◯ No
- ◯ Not Sure
- ◯ Yes

Page 7

## Prescription Preparation Workarounds

**13. Are online pharmacy/medical resources available to the pharmacy staff in order to provide job specific information or content on any of the pharmacy department's computer terminals?**

- ◯ Yes
- ◯ Not Sure
- ◯ No

**14. What is the number of computer terminals located in your pharmacy department?**
**DO NOT include cash registers or point-of-sale (POS) ONLY terminals**

[ ]

**15. Which of the following types of technology does your pharmacy currently use during normal the workflow of preparing medications?**

****Check All That Apply****

- ☐ Voice Mail or Answering Machine
- ☐ Imaging Device (Prescription Scanner)
- ☐ Unit Dose Packing/Sealing Machine or Robot
- ☐ Faxes (stand alone machine or computer generated)
- ☐ Electronic Counting Device (Check Weigh Scale or Infrared Counter)
- ☐ Radio Frequency Identification (RFID; Tags affixed to inventory to track movement)
- ☐ Automated Counting/Dispensing Machine or Robot
- ☐ Electronic Prescriptions (eRx)
- ☐ Bar Code Scanner
- ☐ Other (please specify; separate equipment by commas if needed)

[ ]

## Prescription Preparation Workarounds

**16. Considering what you have answered to the previous questions, how well are the different types of technology integrated with one another at your pharmacy?**

***Integration refers to the ability of the technology to share information between system components.**

- ◯ Not at all - 0% Integrated
- ◯ Approximately 25% Integrated
- ◯ Approximately 50% Integrated
- ◯ Approximately 75% Integrated
- ◯ Perfectly - 100% Integrated
- ◯ Other (please specify)

**17. Does your pharmacy provide a smartphone or PDA (personal digital assistant) for use by the staff?**

- ◯ No
- ◯ Yes
- ◯ Other (please specify)

**18. Do you provide your own a smartphone or PDA (personal digital assistant) for work related use during working hours at your pharmacy?**

- ◯ No
- ◯ Yes
- ◯ Other (please specify)

## Prescription Preparation Workarounds

### Workaround Description

**Below is a generalized workflow of the prescription preparation process in a typical** pharmacy. **Each process category of this workflow has multiple steps a user must** complete in order to proceed to the next process category.


**WORKAROUND is defined as any workflow action that is not included as part of the official pharmacy prescription preparation process workflow.**

Steps or actions taken by users contained in the workflow typically follow an organization's specific pattern. This pattern may be mandated, implied, or necessary due to perceived efficiency, safety, or administrative reporting purposes. It may be possible, in some instances to "workaround" specific steps or actions in a workflow allowing the user to proceed to the next step despite skipping or altering a step in the organization's specific workflow.

An example for illustration:
A nurse's station at a local Hospital is required to do a daily medication count reconciliation. Each day a list of the on-hand medications and quantities kept at that specific station is printed. A nurse is then required to verify that they have the correct medication and quantity indicated by the printout.

The correct workflow process involved notifying the pharmacy if any overages or shortages were identified. The workaround that developed was to use tape to stick a medication to the bottom of a desk at the station where the excess on-hand quantity was discovered. The workaround benefit being that if the on-hand quantity is short at a later time it can be quickly resolved by retrieving the taped medication from beneath the desk.

Page 10

# Prescription Preparation Workarounds

## Workarounds and Rx Input

Some people have reported that workarounds are needed when putting in prescriptions or patient information with their pharmacy management software under specific circumstances.

Example:

Mr. Smith states that he believes that his ex-wife has been picking up his pain medication without his permission. He wants a note put in his profile that only he can pickup his medication and must present a photo ID. Requiring a photo ID is not a common procedure at this pharmacy and the pharmacy management software does not have a "patient notes" or "comments" section. An asterisked comment is put in the address field of Mr. Smith's profile because the address is printed on his check-out slip and medication bottle label which achieves the patient's request by prompting the cashier to ask for an ID at check-out.

**WORKAROUND is defined as any workflow action that is not included as part of the official pharmacy prescription preparation process workflow.**

**19. The following is a list of the technology commonly used in pharmacies for prescription and/or patient information input.**

How often is a workaround needed at your pharmacy while using each type of **technology listed below?**

| | Never - the official workflow is always followed | Infrequently | Frequently | Very Frequently | Every Time - this technology does not function properly | N/A - we do not have this type of technology |
|---|---|---|---|---|---|---|
| Pharmacy Management Software | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Electronic Prescribing | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Prescription Imaging Devices | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| General Internet Accessibility | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |
| Fax Machine | ◯ | ◯ | ◯ | ◯ | ◯ | ◯ |

20. Is there anything else that you wish to share about the use workarounds at your **pharmacy during prescription input?**

Page 11

# Prescription Preparation Workarounds

## Workarounds and Rx Filling

Some people have also reported that workarounds are needed when dispensing, filling or preparing prescriptions with some of their technology under specific circumstances.

Example:
Tom's Pharmacy is using a pharmacy system that is unable to bill an insurance company for a partially filled prescription in the event that they do not have all of the 30 tablets of Lipitor for Mrs. Sander's prescription. This leads to a series of workarounds required in order to dispense her prescription. First, the full quantity of the prescription is entered and billed (could be judged as fraudulently) to the insurance company despite only dispensing 8 tablets. Then, Tom's check-weigh scale has to be over-ridden because of the discrepancy in the filled quantity versus inputted quantity and a written note must be made on Mrs. Sander's medication bottle and profile that she is owed the remainder of 22 tablets at no additional charge.

**WORKAROUND is defined as any workflow action that is not included as part of the official pharmacy prescription preparation process workflow.**

**21. The following is a list of the technology commonly used in pharmacies for** prescription dispensing, filling or preparation.

How often is a workaround needed at your pharmacy while using each type of **technology listed below?**

| | Never - the official workflow is always followed | Infrequently | Frequently | Very Frequently | Every Time - this technology does not function properly | N/A - we do not have this type of technology |
|---|---|---|---|---|---|---|
| Robotic/Automated Dispensing Machine | ○ | ○ | ○ | ○ | ○ | ○ |
| Radio Frequency Identification (RFID; Tags affixed to inventory to track movement) | ○ | ○ | ○ | ○ | ○ | ○ |
| Bar Code Scanner - Filling | ○ | ○ | ○ | ○ | ○ | ○ |
| Unit Dose Packing Machine | ○ | ○ | ○ | ○ | ○ | ○ |
| Computer-assisted TPN (Total Parenteral Nutrition) | ○ | ○ | ○ | ○ | ○ | ○ |
| Electronic Counting Device (Scale) | ○ | ○ | ○ | ○ | ○ | ○ |

22. Is there anything else that you wish to share about the use workarounds at your pharmacy during prescription filling?

Page 12

# Prescription Preparation Workarounds

## Workarounds and Pharmacist Functions

And lastly, some people have reported that workarounds have been used while performing pharmacist functions.

Example:
At Anywhere Apothecary the corporate workflow states that only pharmacists can check voicemail. In an effort to allow the pharmacist to spend more time with patient's for counseling, a senior technician of 12 years has been given permission by a staff pharmacist to check the voicemail and to write up any new prescriptions left by a doctor's office.

**WORKAROUND is defined as any workflow action that is not included as part of the official pharmacy prescription preparation process workflow.**

23. The following is a list of the technology commonly used in pharmacies to assist pharmacists with their clinical and verification responsibilities.

How often is a workaround needed at your pharmacy while using each type of **technology listed below?**

| | Never - the official workflow is always followed | Infrequently | Frequently | Very Frequently | Every Time - this technology does not function properly | No Knowledge of Pharmacist's Use of Workarounds | N/A - we do not have this type of technology |
|---|---|---|---|---|---|---|---|
| Voicemail | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Online Medical/Pharmacy Resources | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Company Provided PDA | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Bar Code Scanner - Verifying | ○ | ○ | ○ | ○ | ○ | ○ | ○ |

24. Is there anything else that you wish to share about the use workarounds at your pharmacy during prescription verification?

## Prescription Preparation Workarounds

**Thank You**

I greatly appreciate your participation and help with my research project.

Due to the anonymous nature of this questionnaire you may continue to receive requests for participation. There are 4 mailings total that will be made in an effort to recruit respondents. If you have completed the questionnaire, I thank you and ask you to disregard the subsequent mailings.

If you would like to be removed from the mailing list feel free to call or email me. If you choose to contact me, please do not indicate whether you completed the questionnaire in order to preserve the respondent anonymity design of the study.

Thank you again for your help. This study has a greater impact due to your participation.

Wes Wilkerson, PharmD
wilketw@auburn.edu
334-750-3893

## APPENDIX B. Initial Postcard

Dear Pharmacist/Technician,

You are invited to participate in a research study approved by the Alabama State Board of Pharmacy and the Auburn University Harrison School of Pharmacy (AU HSOP) to describe workarounds associated with prescription preparation in a pharmacy setting.

After speaking with many of you personally, it seems that despite the many different pharmacy systems in use, many have the same shortcomings. With your help we can better understand the workaround phenomenon and help pharmacy system developers and safety advocates produce better systems for our pharmacies. I, as a practicing pharmacist, realize the impact that the use of workarounds can have on the processes intended to protect our patients, document our actions, and ensure accurate reimbursement for services rendered.

Your participation is completely voluntary and anonymous. A complete study packet will be mailed to you within the next week with a pre-addressed, stamped return envelope. For additional information about the project or to participate now you may go online to: http://pharmacy.auburn.edu/survey

If you would like to opt out of future mailing pertaining to this study for any reason you may do so by contacting me via email or telephone. Thank you for your help with my project and consideration.

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# APPENDIX C. Thank You/Reminder Postcard

Thank you for recently completing the workaround questionnaire!

However, if you have not done it, you are invited to participate in a research study approved by the Alabama State Board of Pharmacy and the Auburn University Harrison School of Pharmacy (AU HSOP) to describe workarounds associated with prescription preparation in a pharmacy setting.

As I mentioned in my previous contact, despite the many different pharmacy systems in use, many have the same shortcomings. With your help we can better understand the workaround phenomenon and help pharmacy system developers and safety advocates produce better systems for our pharmacies. I, as a practicing pharmacist, realize the impact that the use of workarounds can have on the processes intended to protect our patients, document our actions, and ensure accurate reimbursement for services rendered.

Your participation is completely voluntary and anonymous. In case you have misplaced the previous packet, another complete study packet will be mailed to you within the next week with a pre-addressed, stamped return envelope. For additional information about the project or to participate now you may go online to: http://pharmacy.auburn.edu/survey

If you would like to opt out of future mailing pertaining to this study for any reason you may do so by contacting me via email or telephone. Thank you for your help with my project and consideration.

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