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Abstract

Nearly 57% of adult Americans report drinking alcohol in the past month, and 41.5% of current drinkers take alcohol-interactive (AI) medications. Concurrent consumption of both substances can result in adverse interactions. Nurses are in a position to screen and appropriately teach patients. However, little is known about nurses' knowledge of AI medications. The purpose of this study is to determine nurses' knowledge of AI medications and factors that may affect knowledge level. The Jarvis Nursing Knowledge of Alcohol-Interactive Medications survey was developed and distributed to nurses employed by a large Midwestern health system. The final analyzed sample of nurses (n = 211) demonstrated lack of AI knowledge by correctly identifying AI medications only 56.3% of the time. Work environment, years of nursing practice, and educational level did not have a significant influence in AI knowledge. The authors conclude that AI medications should be emphasized in nursing curricula so nurses can exercise more vigilance in nurse-patient interactions.

Nurses' Knowledge of Alcohol-Interactive Medications

Alcohol drinking is a popular and profitable leisure time activity in the United States. In 2014, 71.0% of adult Americans ages 18 years and older reported drinking alcohol at some point in the past year; 56.9% of adult Americans reported drinking least once in the past month, making them current drinkers; and 24.7% reported binge drinking (consuming five or more drinks in one sitting) at least once in the past month (Substance Abuse and Mental Health Services Administration [SAMHSA], 2015). Alcohol consumption is accepted and pervasive in today's American culture.

Prescription medication use has been increasingly common in the United States. Kantor, Rehm, Haas, Chan, and Giovannucci (2015) examined data from the National Health and Nutrition Examination Survey (NHANES) during the years 1999 to 2012 to identify trends in prescription medication use. The authors found that 59% of adult Americans used at least one prescribed medication in the last 30 days in the NHANES 2011-2012 cycle; the stated figure represented an 8% increase from the NHANES 1999-2000 cycle.

Pharmacologists and prescribers know that both over-the-counter and prescription medications, such as medications for allergies, angina, depression, and diabetes, have the potential to interact with alcohol and yield adverse effects (Masters & Trevor, 2015; Weathermon & Crabb, 1999)**.** Medications that interact with alcohol are referred to as alcohol interactive (AI) medications. Concurrent consumption of both substances can result in alcohol-related adverse drug reactions (ADRs), such as sedation, increased risk for bleeding, and hypotension (Weathermon & Crabb, 1999**).** Many cases of alcohol-related ADRs result in emergency department (ED) visits. Holder (1992) estimated that alcohol-drug interactions contributed to 25% of ED admissions. Castle, Dong, Haughwout, and White (2016) provided a more modest estimate of 11.6 ED visits per 100,000 people ages 12 and over were related to alcohol-drug interactions. The estimate was made by assessing a sample of ED visits from 2005 to 2011, ranging from 229,211-383,977 visits within a given year (Castle, Dong, Haughwout, & White, 2016).

Alcohol-related ADRs merit the medical attention of healthcare providers. Nurses make up the largest body of United States healthcare providers, with more than 3.1 million registered nurses nationwide (Health Resources and Services Administration, 2010). The nation's nurses are at the frontline of patient care and are in a position to detect potential alcohol-related ADRs and provide patient education accordingly (Mitchell et al., 2015). A prerequisite to accurate health education is knowledge of health content. The aims of this study are to:

1) Assess registered nurses' level of knowledge of AI medications.

2) Determine whether work environment, years in practice, and level of formal education contribute to a higher level of AI medication knowledge.

3) Determine to what extent the survey, Jarvis Nursing Knowledge of AI Medications, is reliable and valid when administered to registered nurses.

Background

Physiology of Alcohol Metabolism and Interactions with Medications

Over 90% of ingested alcohol is metabolized in the liver; the remainder is excreted through the lungs and in urine (Masters & Trevor, 2015). Acute alcohol consumption has notable effects on the central nervous system (CNS), heart, and smooth muscle of the body. Alcohol depresses the CNS by inhibiting the effects of glutamate, the main excitatory neurotransmitter in the CNS, and enhancing the effects of gamma-aminobutyric acid, GABA, the main inhibitory neurotransmitter in the CNS. In the heart, alcohol depresses myocardial contractility and slows systemic circulation. In smooth muscle, alcohol dilates blood vessels through two mechanisms. A metabolite in alcohol metabolism, acetaldehyde, directly relaxes smooth muscle. Alcohol also depresses the vasomotor center of the CNS, also resulting in vasodilation (Masters & Trevor, 2015).

Alcohol-drug interactions are dependent on a number of factors, such as timing of consumption of the medication(s), timing of consumption of alcohol, dosage of medication, type of medication, and amount of alcohol. In general, alcohol-drug interactions can be categorized into two types: pharmacokinetic and pharmacodynamics (Weathermon & Crabb, 1999). Pharmacokinetic interactions occur when the presence of alcohol interferes with the normal metabolism of the other medication. The metabolism and excretion of the medication may be delayed due to the medication having to compete with alcohol for breakdown by the same enzymatic pathway. Conversely, the metabolism and excretion of the medication may be accelerated in chronic drinkers whose medication-metabolic pathway was enhanced by chronic consumption of alcohol; the accelerated metabolism and excretion may result in decreased therapeutic effects of the active form of the medication. Pharmacodynamic interactions are independent of enzyme activity and refer to additive effects of alcohol and medications on the human body (Weathermon & Crabb, 1999). For instance, concurrently ingesting a medication with CNS depressant qualities and alcohol will yield a greater degree of CNS depression than if the two substances were consumed independently.

Prevalence of Alcohol-Medication Interactions

Much of the literature addressing the prevalence of AI medications focuses on the more vulnerable population of older adults (Adams, 1995; Cousins et al., 2014; Forster, Pollow, & Stoller, 1993; Immonen, Valvanne, & Pitkala, 2013; Pringle, Ahern, Heller, Gold, & Brown, 2005; Qato, Manzoor, & Lee, 2015). The vulnerability is a result of the higher likelihood that older adults engage in polypharmacy and are more sensitive to the effects of alcohol (Moore, Whiteman, & Ward, 2007). The earliest reported studies were performed in the 1990s. Forster, Pollow, and Stoller (1993) found that 25% of community-based older adults were at risk for at least one alcohol-related ADR, while 15% were at risk for multiple alcohol-related ADRs. The most common risk was that of over-the-counter pain medications and alcohol, as both substances delay clotting time and increase the risk of bleeding. Adams (1995) estimated 38% of older adults concurrently consumed alcohol and AI medications, the most common being cardiovascular agents such as antihypertensive medications.

More recent studies, international and domestic, have proposed different estimates. Pringle, Ahern, Heller, Gold, and Brown (2005) used data from a state-based medication assistance program for older adults and found that 77% of program participants were exposed to AI medications; concurrent alcohol use was found in 19% of program participants. Qato, Manzoor, and Lee (2015) used data from the National, Social life, Health and Aging Project to characterize the extent of drug-alcohol interactions in older adults. The authors found that 20% of older adults were at-risk for a drug-alcohol interaction. This estimate is more striking due to the authors defining regular drinking as consuming alcohol at least weekly, rather than the SAMHSA definition of one drink per month for current drinking.

The high risk for alcohol-medication interactions in older adults is found internationally. Immonen, Valvanne, and Pitkala (2013) assessed the possibility of drug-alcohol interactions among older adults in Finland. The authors determined that 34.9% of current drinkers (one drink per month) were on AI medications. In Ireland, Cousins et al. (2014) used a sample of adults ages 60 years and older to estimate the prevalence of AI medications and concurrent alcohol consumption. The authors found that 60% of older adults concurrently used AI medications and alcohol.

Two United States studies used data from the NHANES, a research survey program conducted by the National Center for Health Statistics. Jalbert, Quilliam, and Lopane (2008) used NHANES 1999-2002 data and found that 13.5% of participants ages 20 and over took one or more AI medications; 60.5% of those participants reported concurrent drinking. To determine the national prevalence of AI prescription medication use among current drinkers ages 65 years and older, Breslow, Dong, and White (2015) used the same methodology as Jalbert, Quilliam, and Lopane (2008) but extended the data collection interval to 1999-2010. The authors found that 41.5% of current drinkers were on AI medications. Thus, these studies show that AI medications are abundantly available to the United States population. However, with the exception of Jalbert, Quilliam, and Lopane (2008), the literature is limited by its focus on the risk of alcohol-medication interactions in older adults rather than people of all ages.

Nursing Education and Knowledge on Substance Misuse

The American Association of Colleges of Nursing's (AACN, 2008) *The Essentials of Baccalaureate Education for Professional Nursing Practice* delineates core standards that baccalaureate-degree nursing programs must meet when developing curricula. Essential VII: Clinical Prevention and Population Health defines health promotion and disease prevention as essential skills a baccalaureate nurse should have. Competency in identifying risky concurrent use of alcohol and AI medications is consistent with Essential VII. However, the literature shows a deficit in alcohol-drug related knowledge of graduate nurses and content in nursing curricula over the last three decades, with a minority of studies addressing drug misuse at all (Happell & Taylor, 1999; Hoffman & Heinemann, 1987; Howard, Walker, Walker, & Suchinsky, 1997;

Mollica, Hyman, & Mann, 2011; Murray & Li, 2007; Murray & Savage, 2010; Vadlamudi, Adams, Hogan, Wu, & Wahid, 2008;). Vadlamudi, Adams, Hogan, Wu, and Wahid (2008) claimed that healthcare educators are faced with time constraints that do not allow for focused content on alcohol when they are trying to establish a broad foundation of healthcare knowledge. The deficit of alcohol misuse content in nursing curricula results in nurses unable to properly identify, refer, and educate patients who misuse alcohol (Adams, Hogan, Wu, & Wahid, 2008; Rassool & Rawaf, 2008a; Rassool & Rawaf, 2008b; Vadlamudi, Tsai et al., 2010). Alcohol misuse in the literature is typically defined as the consumption of psychoactive substances in ways they were not intended and that causes physical, social and psychological harms (Rassool, 2004). Alcohol abuse, addiction, and dependence are salient issues when referring to alcohol misuse, but alcohol-medication interactions are also considered in alcohol misuse.

Nurses represent the largest group of healthcare professionals who are often the initial assessors for high-risk alcohol use (Rassool, 1993). However, nursing schools only allot a few hours of alcohol-related content, focusing mainly on abuse, addiction, and dependence. Hoffman and Heinemann (1987), the oldest study concerning alcohol education in nursing curricula, surveyed 242 nursing programs in the United States to find how much substance abuse education is provided to nursing students. The most frequently reported range of hours is one to five; 87% of surveyed schools reported offering alcoholism content, while only 35% of surveyed schools reported offering drug abuse content. Mollica, Hyman, and Mann (2011) evaluated if alcohol education in undergraduate nursing curricula had changed since the findings of Hoffman and Heinemann (1987). The authors performed a cross-sectional survey of 117 traditional 4-year baccalaureate nursing programs in Northeastern United States. They found that 56% of schools offered one to five hours of didactic alcohol education, and 30% of schools offered one to five clinical hours of alcohol education. Current findings show little change in alcohol education in United States baccalaureate nursing programs in two decades. A similar paucity of alcohol education is found in the United Kingdom. There, inclusive range of time allotted for didactic and clinical alcohol education in undergraduate nursing programs are two to 10 hours (Cund, 2013; Holloway & Webster, 2013; Howard, Walker, Walker, & Suchinsky, 1997). Specialist drug and alcohol nurses have reported poor preparation, as well as a lack of opportunities for alcohol- and drug-related continuing education in their own specialty (Happell & Taylor, 1999). Nurse practitioners have reported the same lack of alcohol-drug content in graduate school (Campbell-Heider et al., 2009). Overall, the education of alcohol misuse is lacking in nursing education.

Though nursing schools have not significantly integrated more drug- and alcohol-related content in their curricula, there have been a couple of notable attempts. Rassool (2004) described the development of a substance misuse curriculum for non-addictions specialist nurses. British nurses from any field could take advantage of the continuing education and earn a Certificate in Substance Misuse in England (Rassool, 2004). In the United States, an online curriculum was developed by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) (Murray & Savage, 2010). The online curriculum available on the NIAAA website includes PowerPoint lectures, handouts, resources, modules, and suggested classroom activities that span fourteen alcohol-related topics (e.g., alcohol’s effect on the brain and behavior, prevention of harm from alcohol use) (Murray & Savage, 2010).

There is a dearth of evidence in the literature of the degree to which AI medications are covered as sufficiently as alcohol abuse, addiction, and dependence when addressing alcohol misuse. Neafsey and Shellman (2002) is the only study found that quantified the level of knowledge nurses have about interactions of medications and alcohol. The authors distributed a multiple-choice survey of 14 interactions among over-the-counter medications, prescription medications, and alcohol to three groups of nurses: visiting nurse agency registered nurses (VNARNs) (n=20), undergraduate nursing students (n=20), and graduate nursing students (n=31). Medications the survey covered include non-steroidal anti-inflammatory drugs (e.g., aspirin), acetaminophen, antacids, antihypertensives, warfarin, and zinc. Surveyed nurses were only capable of correctly identifying 49-59% of medication-alcohol interactions. The authors found VNARNs had significantly greater knowledge than the graduate nursing students, though the study's major shortcoming is small sample sizes.

Methods

Sample

A convenience sample of 931 registered professional nurses employed by a large Midwestern health system was used in this study. The health system consists of two inpatient locations and 20 outpatient clinics in Illinois. The health system has Magnet accreditation, a credential awarded by the American Nurses Credentialing Center to reflect nursing excellence. Eligibility requirements for participants in this study included being 18 years of age or older, English literacy, and being a registered professional nurse employed by the health system.

Data collection occurred over four weeks. Of the potential 931 registered professional nurses, 503 participants completed the electronically distributed survey, resulting in a 54% response rate. Completion of the survey was considered consent (Appendix A). Exclusion criteria include partial completion, duration of survey completion under five minutes, and at least three medication questions skipped. The final sample size for data analysis was 211.

Instrument

Knowledge of AI medications was measured by using the Jarvis Nursing Knowledge of AI Medications (JaNKAM) Survey, which was developed in 2016 (Appendix B). The survey includes questions pertaining to 15 of 25 most commonly prescribed medications in the United States, using data from the Centers for Medicare and Medicaid Services, the Institute for Healthcare Informatics, and the Centers for Disease Control and Prevention. Of the 15 medications, 10 are AI. The survey asks the participant: 1) if patient teaching on AI medications is part of a typical patient interaction; 2) which resource the participant would most likely use to learn more about AI medications; 3) a series of questions regarding specific AI medications; and 4) of any additional comments she or he would like to make. Each set of questions pertaining to a medication has a primary question and a secondary question. The primary question asks whether or not the medication is AI. If the respondent answers no, the survey continues to the next set of questions about another medication. If the respondent answers yes, the survey transitions to the secondary question that asks what alcohol related ADR might occur. Each secondary question has one correct answer and three distractors. The survey includes both the generic and the brand names of each drug.

Data Analysis

Data analysis was conducted by using IBM SPSS Statistics (version 22). Descriptive statistics and frequencies were used to describe demographic characteristics and to score the accuracy of participants' answers to the JaNKAM survey. Because data were not normally distributed, nonparametric tests were used to answer Aim 2. Specifically, the Mann-Whitney *U* test and the chi-square test were utilized. The Mann-Whitney *U* test is a nonparametric test that determines if the difference between two means is statistically significant; it is the nonparametric equivalent of the *t*-test (Field, 2009). The chi-square test determines if there is a relationship between two or more categorical variables (Field, 2009). The observed frequencies were classified simultaneously for years in nursing practice. The join frequencies were tested against the null hypothesis (e.g., there is no differences within nurses' knowledge of AI medications and the number of years they have practiced in nursing).

Due to a large sample size, however, parametric tests were also utilized for further investigation of statistical significance. Specifically, *t*-tests and 1-way Analysis of Variance (ANOVA) were utilized. A 1-way ANOVA was conducted to compare mean scores between three or more groups of nurses. The level of statistical significance for this study was $\alpha = 0.05$.

No a priori power analysis was conducted, as no known population μ was available to compare finding against. Only one clinical site was used for this pilot study. However, due to the robust response rate, post hoc power analysis was conducted. A small effect size was chosen, as the authors reasoned that the sample of nurses would not differ when compared to the population of United State nurses. The effect size is an objective and often standardized measure of the magnitude of an observed effect (Field, 2009). With a small effect size (0.20), $\alpha = 0.05$, $df = 1$, n = 211, Cohen (1988) determined that the power for the chi-square test is 81%. For a $df = 2$, power was determined to be 72%.

Results

Demographics

The majority of participants in the sample were female (n = 200, 94.8%). All age groups were represented with the highest number in ages 50-59 (n = 55, 26.1%), followed by the ages 30-39 (n = 50, 23.7%). Most of the participants identified themselves as Caucasian (n = 192, 91.0%), followed by "Other" (n = 7, 3.3%). The nurses surveyed were fairly evenly distributed between working in the hospital (n = 108, 51.2%) and working in an outpatient setting (n = 101, 47.9%). The highest degree held by 96 (45.5%) of participants was an Associate Degree in Nursing (ADN), followed by 91 (43.1%) participants with a Baccalaureate in Nursing (BSN). Regarding years worked in nursing practice, the majority of nurses worked 21 years or more (n = 77, 36.5%), followed by nurses who worked 1-5 years (n = 50, 23.7%), and nurses who worked 6-10 years (n = 35, 16.6%). A demographic breakdown is found in Tables 1 and 2 (Appendix C).

Registered Nurses' Level of Knowledge of AI Medications

The first aim of the study is to determine nurses' knowledge of AI medications. The measure of knowledge is based on the number of answers correctly identified. A JaNKAM score is defined as a percent of correct responses. The median JaNKAM score was 60%, and the mean score was 56.3%, *SD* = 19.90%, ranged from 0% to 93.3%. Nurses only correctly identified about 56-60% of medications as AI or non-AI. The participants (n=2) with a score of 0% did not meet any exclusion criteria and were therefore kept. The most correctly classified medication is hydrocodone-acetaminophen (Vicodin); 98.6% of the sample identified the medication is AI. The least correctly classified medications were ciprofloxacin (Cipro) and prednisone (22.7%). Both medications are not AI.

Also, the AI medications were exclusively score. Rather than measuring AI medication knowledge by a participant's ability to correctly discriminate medications as AI or non-AI, the authors also observed how well participants detect AI medications from a list of exclusively AI medications. The median score was 80%, and the range was 0% to 100%; the mean score was 70.2%, *SD* = 27.92. Nurses were capable of correctly identifying 70% of AI medications from a list of AI medications. Score breakdowns for all medications and exclusively AI medications are found in Tables 3-6 (Appendix D).

Comparison of JaNKAM Scores

The second aim of this study is to determine whether work environment, years in practice, and level of formal education contribute to a higher level of AI medication knowledge.

Work environment. The scores of nurses who worked at the hospital and nurses who worked at outpatient clinics were compared. AI medication knowledge in hospital nurses (*Mdn* = 60.0%; *M* = 55.42%) did not differ significantly from clinic nurses (*Mdn* = 60.0%; *M* = 57.10%), *U* = 5072, *z* = -0.882, *ns*, *r* = -0.06. These results suggest that nurses in both work environments have approximately equal levels of knowledge of AI medications. The *t*-test results reinforced the lack of statistical significance. Scores by groups are found in Table 7 (Appendix E).

Level of formal education. The scores of nurses with an Associates Degree in Nursing (ADN) and nurses with a Bachelor of Science in Nursing (BSN) were compared; an ADN is typically obtained in two-year programs, and a BSN is typically obtained in four-year programs. AI medication knowledge in ADN nurses (*Mdn* = 60%; *M* = 56.25%) did not differ significantly from BSN nurses (*Mdn* = 60%; *M* = 56.41%), *U* = 4284.5, *z* = -0.228, *ns*, *r* = -0.017. These results suggest that ADN and BSN nurses have approximately equal levels of AI medication knowledge. The *t*-test results reinforced the lack of statistical significance. Scores by groups are found in Table 7 (Appendix E).

Years of nursing practice. The scores of nurses grouped into three ranges of nursing practice were compared. The group ranges for years in nursing practice are of the following: 0-5 years, 6-20 years, and 21 or more years. There was no significant association between years in nursing practice and accurate discrimination of medications as AI or non-AI χ^2 (28) = 27.54, *p* = 0.48, Cramer's *V* = 0.225. Cramer's *V* is an effect size commonly associated with the chi-square test; the stated value signifies a small effect size but is not statistically significant. These results suggest that years in nursing practice do not affect levels of AI medication knowledge. The

ANOVA results reinforced the lack of statistical significance. Further, post-hoc analysis was conducted. One cell of the crosstabulation, 21 years and over crossed with 12 correct answers, had an adjusted residual greater than 1.96. However, the analysis still indicated no statistical significance.

Reliability and Validity of the JaNKAM

The third aim of the study is to determine the reliability and validity of the JaNKAM survey. The face validity of the JaNKAM survey was established prior to distribution by three alcohol researchers. One researcher approved the survey with no suggestions for changes. The two other researchers gave feedback that was adopted for the final survey draft.

To determine the reliability of the JaNKAM, internal consistency was measured using the alpha coefficient Kuder-Richardson 20 (KR-20). Internal consistency is the degree to which all items on a scale measure the same trait (Polit & Beck, 2010). The KR-20 is a reliability index that is used for nominal data that are scored dichotomously (Waltz, Stickland, & Lenz, 2010). The KR-20 is appropriate for the JaNKAM because the survey was scored for accuracy, or in a correct/incorrect dichotomy.

The KR-20 values for primary and secondary questions, both individually and together, were ascertained. The KR-20 value for primary questions was reliable ($\alpha = 0.714$). The KR-20 values for exclusively secondary questions ($\alpha = 0.510$) and inclusively primary and secondary questions ($\alpha = 0.628$) demonstrated lower levels of reliability. Due to the lower degree of reliability of the entire JaNKAM, validity of the JaNKAM should be interpreted with caution.

Discussion

This cross-sectional study examined nurses' knowledge of AI medications, as well as whether or not relationships exist between level of AI medication knowledge and level of education, work environment, and years of nursing practice. The findings demonstrated no significant relationship between level of AI medication knowledge and level of education, work environment and years of nursing. Considering only the 10 of the 15 medications that are actually AI, nurses identified them as such 70% of the time. However, nurses overall were only capable of correctly discriminating 56.3% of the 15 most prescribed medications as AI or non-AI. BSN nurses scored slightly higher than ADN nurses, though the difference in scores was not significant. Nurses with more years of clinical experience scored higher than nurses with less clinical experience, though the difference in scores was not significant. Outpatient clinic nurses scored slightly higher than hospital nurses, though the difference in scores was not significant. Nurses, regardless of years of accumulated practice, work setting, and level of formal education, are not familiar with AI medications.

To the researchers' knowledge, only one previous study (Neafsey & Shellman, 2002) had attempted to measure nurses' level of AI medication knowledge. Neafsey and Shellman (2002) examined level of AI medication knowledge only in a small sample size of community health nurses. The authors primarily focused on over-the-counter medications, while our study thoroughly addressed 15 of the most commonly prescribed medications in the United States. Thus, our study is the first to investigate nurses' knowledge of AI medications among a large number of nurses in all practice settings.

These findings reinforce what is known in the literature about nursing curricula and the low level of preparation for new nurses to engage patients who misuse alcohol. Overall, nursing curricula is deficient in proper alcohol misuse education. Further, little alcohol misuse content in curricula typically address alcohol abuse, addiction, and dependence. The amount of didactic instruction about AI medications is unknown. The mean score of all sampled nurses indicates that nurses must be better trained at differentiating between AI medications and non-AI medications.

Limitations

The convenience sample (n=211), harvested from 503 respondents, was taken from a single site, a large Midwestern health system. Further, the health system holds a Magnet accreditation, reflecting a high standard of nursing excellence. Both a single-site convenience sample at a hospital system with a higher standard of nursing excellence limits generalizability of results to the entire population of United States nurses (Polit & Beck, 2013). The participants were not observed when they completed the JaNKAM, as the survey was distributed electronically. A variety of environmental factors may have prevented nurses from focusing and answering survey items to the best of their abilities. Moreover, unobserved completion of the survey includes the risk of participants searching up correct answers in references such as drug books or the Internet.

The JaNKAM survey was developed for this study, and study limitations come from this pilot survey. The survey was written in a way that collected data nominally; therefore, nominal data limited the options of analysis. There is some flux between nominal and ordinal data in the current study. For the purposes of this study, data for Aims 1 and 2 was categorical and analyzed with the nonparametric statistics. However, the pilot survey will be improved so that its results will afford a more robust statistical analysis in future studies.

Moreover, the authors found that the average amount of time completing the JaNKAM was 22 minutes. Response burden and survey fatigue may have resulted in participants not answering items to the best of their abilities. Further, an error in distribution occurred. The secondary question for metoprolol (Lopressor) was invalid due to a technical error in which a multiple-choice answer was stated as the question.

Responses to the JaNKAM survey may have also been influenced by an acquiescence bias. An acquiescence bias is the tendency in which a respondent agrees to survey questions (Polit & Beck, 2013). The JaNKAM was introduced to respondents as a test for AI medications, which may have primed respondents to answer affirmatively to the primary questions. Evidence supporting the presence of this bias is how participants scored better if the 10 AI medications were exclusively observed rather than the total 15 medications.

Therefore, the survey will be modified for future studies. The next iteration of the survey will have one question per medication. Each medication question will have five multiple-choice answers; the question will ask how the medication interacts with alcohol. The first four multiple-choice answers will be a mechanism-based answer, and the fifth answer will be a statement that the medication does not interact with alcohol. The reduction in the number of questions will ease survey fatigue and response burden, while still sustaining the questions' capabilities of measuring AI medication knowledge. Further, the survey will be redesigned to collect data at levels higher than nominal. For the current study, years of nursing practice and age were collected in nominal intervals. Future modification of the survey will allow respondents to input a precise value. To address acquiescence bias, the next iteration of the survey will include an equal number of AI and non-AI medications, and the questions will be phrased neutrally in if-how form.

The 10 AI medications on the JaNKAM survey are pharmacologically interactive with alcohol, but the clinical significance of the alcohol-medication interaction was not assessed. Before the next iteration of the JaNKAM, an investigator will consult an additional expert (e.g., a medical doctor with a PhD in clinical pharmacology) to discuss each AI medication. The authors of the current study also did not define how many alcohol drinks a patient would need would need to consume daily for alcohol-medication interactions to be clinically significant.

Though the primary questions of the survey were sufficiently reliable (KR-20 value of 0.71), both the secondary questions and the combined primary and secondary questions resulted in insufficient reliability. The reliability of the secondary questions are made further complicated because the appearance of the secondary question is dependent how the participant will respond to the primary question. Moreover, only face validity of the survey was appraised for the current study. Future iterations of the survey should utilize content validity indices to appraise the validity of the JaNKAM survey prior to distribution.

Future Research

The JaNKAM was developed for the purposes of this study. After modification of the survey that addresses its limitations, the survey may be used in future studies and be assessed for changes in reliability and validity. The generalizability of current results should also be reevaluated. Further, although the deficit of alcohol-related material in nursing curricula is well documented in the literature, most studies focused on alcohol abuse, addiction, and dependence. Future studies should aim to precisely measure how much nursing schools cover AI medications with students. Future studies may also investigate how much clinical time is spent by healthcare providers in educating patients about the risks of concurrent consumption of alcohol and medications.

Conclusion

Although 41.5% of current drinkers are prescribed at least one AI medication (Breslow, Dong, & White, 2015), we found that the sampled nurses were not capable of differentiating between AI and non-AI medications from a list of 15 commonly prescribed medications. A key role of nurses is to be vigilant of health risks, such as alcohol-related ADRs, and provide health education accordingly, as defined by *The Essentials of Baccalaureate Education for Professional Nursing Practice* (AACN, 2008). Based on this pilot study, nurses should be given continuing education opportunities to review AI medication content and equip themselves with the essential skills to prevent alcohol-related ADRs.

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Appendix A

Email Invitation Asking Participants to Complete Survey & Consent

Jarvis Survey on Alcohol Interactive Medications

You are invited to participate in a research study on awareness of prescription medications and alcohol drinking. Your responses are important in helping us plan continuing education for nurses. This study is conducted by Carolyn Jarvis and Kyle Serafico from Illinois Wesleyan University.

This study will take about 15 minutes of your time. You will be asked to answer a few basic demographic questions, and questions about specific commonly prescribed medications and their interaction with alcohol.

Your decision to participate in this study is completely voluntary. You have the right to stop your participation at any time without penalty. You may skip any questions you do not want to answer. If you do not want to complete this survey just close your browser.

Your participation in this research will be completely confidential and data will be averaged and reported in aggregate. Possible outlets of these data may be conferences and publication in peer-reviewed journals. Although your participation in this research may not benefit you personally, it will help us very much in planning nursing continuing education regarding alcohol-interactive medications and patient safety.

The primary risk in this study is loss of confidentiality. But, because the survey is being completed online and no identifiable data are being collected, the risk to loss of confidentiality is minimal. All information will remain confidential.

If you have questions about this project, you may contact Carolyn Jarvis, PhD, APRN (309-556-3297; cjarvis@iwu.edu). If you have any questions about your rights as a participant in this study or any concerns or complaints, please contact the Illinois Wesleyan University IRB at 309-556-3255 or via email at irb@iwu.edu.

Please print a copy of this consent form for your records, if you wish.

Your decision to participate, decline, or withdraw from participation will have no effect on your current status or future relations with Carle Foundation Hospital or Illinois Wesleyan University. By completing this survey, you are consenting to participate in this study.

Appendix B

Survey Tool: Jarvis Nursing Knowledge of AI Medications (JaNKAM) Survey

Q1 What gender?
- Female
- Male
- Transgender

Q2 Age in years
- 18-29 years
- 30-39 years
- 40-49 years
- 50-59 years
- 60 years and above (5)

Q3 How many years have you worked in nursing practice?
- 0-1
- 1-5
- 6-10
- 11-15
- 16-20
- 21 years or more

Q4 What is your current role/profession?
- Registered Nurse/Staff Nurse
- Advanced practice nurse
- Nurse educator
- Nurse administrator

Q5 Where in the hospital system do you work?
- Hospital
- Outpatient Clinics

Q6 If you answered "Hospital," which unit?

- ❍ Medical/surgical
- ❍ Step Down
- ❍ Obstetrics
- ❍ Pediatrics
- ❍ NICU
- ❍ CCU/ICU
- ❍ OR/PACU
- ❍ Special procedures
- ❍ Other ____________________

Q7 If you answered "Outpatient Clinics," which Clinic?

- ❍ Family practice
- ❍ Internal medicine
- ❍ Pediatrics
- ❍ Other ____________________

Q8 With what ethnic origin do you affiliate?

- ❍ African American
- ❍ Asian
- ❍ Caucasian
- ❍ Latino/a
- ❍ Other ____________________

Q9 Highest degree held

- ❍ Associate degree in Nursing (ADN)
- ❍ Baccalaureate in Nursing (BSN)
- ❍ Masters in Nursing (MSN)
- ❍ Masters in other field
- ❍ Doctorate Nursing Practice (DNP)
- ❍ PhD in Nursing
- ❍ PhD in other field

Q10 Is patient teaching on alcohol interactive (AI) medications part of your daily routine on all patients?

- ❍ Yes
- ❍ No

Display This Question:

If Is patient teaching on alcohol interactive (AI) medications part of your daily routine on all patients? Yes Is Selected

Q11 How much time do you spend on teaching alcohol-interactive medications?

- ❍ A great deal
- ❍ A lot
- ❍ A moderate amount
- ❍ A little

Q12 If a patient is diagnosed with alcohol use disorder, is patient teaching on alcohol interactive medications part of your daily routine?

- ❍ Yes
- ❍ No

Display This Question:

If If patient is diagnosed with alcohol disorder, is patient teaching on AI medications part of you... Yes Is Selected

Q13 How much time do you spend on teaching AI medications?

- ❍ A great deal
- ❍ A lot
- ❍ A moderate amount
- ❍ A little

Q14 What source would you use to learn about alcohol interactive medications? (Check all that apply)

- ❑ Application on mobile phone
- ❑ Web-based program
- ❑ Pharmacology book
- ❑ Physician or Nurse Practitioner Prescriber
- ❑ Call the pharmacy

Q15 Each question below will identify a common medication given in the hospital or outpatient setting. Assume the patient drinks 1-2 standard alcohol drinks per day. Please look at each medication and answer whether it is alcohol-interactive. If the medication interacts with alcohol, then answer the following question on the way it interacts. Please do not use any device or book references as you answer these questions. We just want to learn a baseline for nursing education. It is OK if you do not know an answer.

Q16 When taken together, do Hydrocodone/Acetaminophen (Lortab, Vicodin, Norco) and alcohol interact?

- Yes
- No
- I have no experience with this medication

Display This Question:

If When taken together, do Hydrocodone/Acetaminophen (Lortab, Vicodin, Norco) and alcohol interact? Yes Is Selected

Q17 How do hydrocodone/acetaminophen and alcohol interact?

- Both substances cause respiratory depression and sleepiness
- Both substances cause high blood pressure crisis
- Both substances cause kidney toxicity
- Alcohol decreases pain relief of hydrocodone/acetaminophen

Q18 When taken together, do simvastatin (Zocor) and alcohol interact?

- Yes
- No
- I have no experience with this medication
- Click to write Choice 4

Display This Question:

If When taken together, do simvastatin (Zocor) and alcohol interact? Yes Is Selected

Q19 How do simvastatin (Zocor) and alcohol interact?

- Both substances increase risk of heart attack
- Both substances increase risk of diabetes
- Alcohol causes high blood cholesterol and cancels statin benefits
- Both substances increase risk of myopathy

Q20 When taken together, do hydrochlorothiazide (Hydrocot) and alcohol interact?

- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do hydrochlorothiazide (Hydrocot) and alcohol interact? Yes Is Selected

Q21 How do hydrochlorothiazide and alcohol interact?
- Both substances increase risk of peripheral edema
- Both substances increase risk of hearing loss
- Both substances increase risk of enlarged breasts in men and menstrual irregularities in women
- Both substances decrease blood pressure

Q22 When taken together, do omeprazole (Prilosec) and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do omeprazole (Prilosec) and alcohol interact? Yes Is Selected

Q23 How do omeprazole and alcohol interact?
- Both substances increase risk of pneumonia
- Both substances increase risk of osteoporosis and fractures
- both substances increase risk of intestinal infection with Clostridium difficile
- Alcohol increases risk of acid rebound when stopping omeprazole

Q24 When taken together, do ibuprophen (Advil) and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do ibuprophen and alcohol interact? Yes Is Selected

Q25 How do ibuprophen and alcohol interact?
- Both substances Increase risk of edema
- Both substances Increase risk for bleeding
- Both substances Increase risk of kidney toxicity
- Both substances increase risk of high blood potassium

Q26 When taken together, do levothyroxine (Levoxyl, Synthyroid) and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do levothyroxine (Levoxyl, Synthyroid) interact? Yes Is Selected

Q27 How do levothyroxine and alcohol interact?
- Alcohol reduces levothyroxine absorption
- Alcohol increases levothyroxine metabolism
- Both substances increase risk of myxedema coma
- Both substances increase risk of simple goiter

Q28 When taken together, do lisinopril (Zestril, Prinivil) and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do lisinopril (Zestril, Prinivil) interact? Yes Is Selected

Q29 How do lisinopril and alcohol interact?
- Both substances increase risk of edema of tongue, lips or eyelids
- Both substances decrease blood pressure
- Both substances increase risk of cough
- Both substances increase risk of high blood potassium

Q30 When taken together, do amlodipine (Norvasc) and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do amlodipine (Norvasc) interact? Yes Is Selected

Q31 How do amlodipine and alcohol interact?
- Both substances increase risk of headache
- Both substances increases risk of peripheral edema
- Both substances increase risk of constipation
- Both substances decreased blood pressure

Q32 When taken together, do furosemide (Lasix) and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do furosemide (Lasix) and alcohol interact? Yes Is Selected

Q33 How do furosemide and alcohol interact?
- Both substances decrease blood pressure
- Both substances increase risk of potassium loss
- Both substances increase risk of hearing loss
- Alcohol stops the diuretic effect of furosemide

Q34 When taken together, do ciprofloxacin (Cipro) and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do ciprofloxacin (Cipro) and alcohol interact? Yes Is Selected

Q35 How do ciprofloxacin and alcohol ineract?
- Both substances increase risk of tendon injury
- Both substances cause nausea and vomiting
- Both substances increase risk of Candida infections
- Both substances increase risk of severe sunburn

Q36 When taken together, do prednisone and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:
If When taken together, do prednisone and alcohol interact? Yes Is Selected

Q37 How do prednisone and alcohol interact?
- Both substances suppress the adrenal glands
- Both substances increase risk of fungal infection
- Both substances increase physiologic stress
- Alcohol speeds up glucocorticoid withdrawal

Q38 When taken together, do metformin (Glucophage) and alcohol interact?
- Yes
- No
- I have no experience with this medication

Display This Question:

If When taken together, do metformin (Glucophage) and alcohol interact? Yes Is Selected

Q39 How do metformin and alcohol interact?

- Both substances decrease appetite and cause nausea and vomiting
- Both substances cause weight gain
- Both substances allow buildup of lactic acid in the blood
- Both substances increase risk of acute kidney failure

Q40 When taken together, do gabapentin (Neurontin) and alcohol interact?

- Yes
- No
- I have no experience with this medication

Display This Question:

If When taken together, do gabapentin (Neurontin) and alcohol interact? Yes Is Selected

Q41 How do gabapentin and alcohol interact?

- Both substances cause dizziness and sleepiness
- Both substances increase risk for headache
- Both substances increase risk for peripheral edema
- Both substances cause blurred vision

Q42 When taken together, do metoprolol (Lopressor) and alcohol interact?

- Yes
- No
- I have no experience with this medication

Display This Question:

If When taken together, do metoprolol (Lopressor) and alcohol interact? Yes Is Selected

Q43 Both substances increase risk of migraine headaches

- Both substances increase risk of hyperthyroidism
- Both substances cause constriction of breathing tubes
- Both substances decrease blood pressure

Q44 When taken together, do losartan (Cozaar) and alcohol interact?

- Yes
- No
- I have no experience with this medication

Display This Question:

If When taken together, do losartan (Cozaar) and alcohol interact? Yes Is Selected

Q45 How do losartan and alcohol interact?

- ❍ Both substances cause swelling of the lips, tongue or eyelids
- ❍ Both substances decrease blood pressure
- ❍ Both substances cause kidney failure
- ❍ Both substances increase levels of potassium in the blood

Q46 Any additional comments?

Appendix C

Table 1: Demographic Characteristics of Participants (Sex, Age, Ethnicity, Work Setting)

Variable	**Actual Number**	**% of total sample**
Sex		
Female	200	94.8
Male	11	5.2
Age		
18-29 years	41	19.4
30-39 years	50	23.7
49-49 years	40	19.0
50-59 years	55	26.1
60 years and above	25	11.8
Ethnicity		
African American	5	2.4
Asian	6	2.8
Caucasian	192	91.0
Latino/a	1	.5
Other	7	3.3
Work Setting		
Inpatient Hospitals	108	51.2
Outpatient Clinics	101	47.9

Table 2: Demographic Characteristics of Participants (Formal Education, Years in Nursing)

Variable	**Actual Number**	**% of total sample**
Level of Formal Education		
Associate Degree in Nursing (ADN)	96	45.5
Bachelor’s of Science in Nursing (BSN)	91	43.1
Master’s of Science in Nursing (MSN)	16	7.6
Master’s in other field	4	1.9
Years in Nursing Practice		
0-1 years	3	1.4
1-5 years	50	23.7
6-10 years	35	16.6
11-15 years	21	10.0
16-20 years	25	11.8
21 years or more	77	36.5

Appendix D

Table 3: Overall Score Breakdown of the JaNKAM

Percent Correct

N	Valid	211
	Missing	0
Mean		56.2717
Median		60.0000
Std. Deviation		19.90458
Variance		396.192
Range		93.33
Minimum		.00
Maximum		93.33

Table 4: Breakdown of JaNKAM Scores by Medication: Primary Questions

Medication	**Frequency of Correct Response to Primary Question (n = 211)**	**Proportion**
Hydrocodone-Acetaminophen	208	98.60%
Simvastatin	51	24.20%
Hydrochlorothiazide	136	64.50%
Omeprazole	75	35.50%
Ibuprofen	152	72.00%
Losartan	115	54.50%
Metoprolol	147	69.70%
Gabapentin	136	64.50%
Ciproflaxacin	48	22.70%
Metformin	159	75.40%
Levothyroxine	77	36.50%
Prednisone	48	22.70%
Lisinopril	139	65.90%
Furosemine	159	75.40%
Amlodipine	131	62.10%

Table 5: Breakdown of JaNKAM Scores by Medication: Secondary Questions

Medication	**Frequency of Correct Response to Secondary Question**	**Number of "Yes" Responses to Primary Question**	**Proportion**
Hydrocodone-Acetaminophen	187	208	89.90%
Simvastatin	X	X	X
Hydrochlorothiazide	122	136	89.70%
Omeprazole	X	X	X
Ibuprofen	115	152	75.70%
Losartan	83	115	72.20%
Metoprolol	Error	Error	Error
Gabapentin	123	136	90.40%
Ciproflaxacin	X	X	X
Metformin	59	159	37.10%
Levothyroxine	X	X	X
Prednisone	X	X	X
Lisinopril	108	139	77.70%
Furosemine	62	159	39%
Amlodipine	110	121	90.90%

X – The secondary question has no correct answer, as the medication is not alcohol-interactive

Table 6: Breakdown of JaNKAM Scores of Exclusively AI Medications

% Scores of Exclusively AI Medications

N	Valid	211
	Missing	0
Mean		70.2
Median		80.0
Std. Deviation		27.92
Variance		1
Range		10
Minimum		00
Maximum		10

Appendix E

Table 7: Statistics by Work Setting and Formal Education

Work Setting	**N**	**Mean**	**Median**	**Std. Deviation**	**Std. Error Mean**
Hospital	108	55.6173	60.0000	18.68273	1.79775
Outpatient Clinics	101	57.0957	60.0000	20.94258	2.08387
Formal Education					
Associate degree in Nursing (ADN)	96	56.2500	60.0000	21.66869	2.21155
Baccalaureate in Nursing (BSN)	91	56.4103	60.0000	19.20154	2.01287