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The Effect of Several Factors on Student Pharmacists' Choice of Drug Information Resources

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Authors' contributions

This work was carried out in collaboration among all authors. Authors JWG and MP designed the study, performed the statistical analysis and wrote the first draft of the manuscript. Authors JWG, HM and MP designed the survey used in the study. Authors HM, AH, and IP reviewed data analysis and wrote second draft of manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The provision of drug information (DI) is a fundamental responsibility of pharmacists. The availability of advanced technology and mobile devices has greatly affected how drug information is retrieved. Utilization of these resources and references are unique skills taught in pharmacy programs to help meet the need of pharmacists in practice and to meet national accreditation standards. Currently there is little information on how different factors influence pharmacy students' choice of drug information resources.
Methods: A prospective, cross-sectional survey was developed to assess pharmacy students' utilization of tertiary DI resources by age, gender, and year in professional program. The survey was developed using the software Qualtrics® and contained questions pertaining to the selection of

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specific tertiary DI resources used most often for a variety of DI topics. Differences between groups were calculated using ANOVA.
Results: Students in their P4 year utilized tertiary DI resources more frequently than students in their P1 and P2 year (p= <0.001, 0.001 respectively). There were no differences in the frequency of resource utilization between males and females surveyed (p=0.656, MD = 0.0652). Total usage of DI resources differed by year in professional school.
Conclusion: The results of this study may be beneficial to pharmacy schools as it provides insights into the factors that influence student preference for tertiary drug information resources. This study found that age, year in school, and type of drug information request impacted students' use of tertiary DI resources.

Keywords: Drug information; pharmacy education; resources; medication information; pharmacy students.

1. BACKGROUND

The provision of drug information (DI) is a fundamental responsibility of pharmacists and this information helps to ensure that patients receive optimal therapy [1,2]. Pharmacists are trained to provide information to patients and other health care professionals and must be skilled in the retrieval, analysis, and delivery of this information [3,4]. This is especially important when there is an immediate need to provide drug information (e.g. acute care setting) [2]. There is a need to provide multiple opportunities to apply drug information skills prior to graduation to be best prepared for practice.

Professional development and enhancement of drug information and literature evaluation skills are taught throughout the professional education years [5-9]. Students must be able to retrieve, analyze, and interpret scientific literature in pursuit of optimizing patient care [9]. These skills can be developed on Advanced Pharmacy Practice Experiences throughout a pharmacy based curriculum [10]. Students who have had more training and experience in these focused areas have been shown to be more prepared for professional practice [11].

The Accreditation Council for Pharmacy Education (ACPE) is the accrediting body that approves and monitors the pharmacy curriculum and provides standards and guidance on required professional development proficiencies for all students of pharmacy [9,12]. Students are expected to develop proficiency in several emphasized areas including communication skills, drug information, experiential education, practical application of knowledge, inter professional teamwork, patient safety, professionalism, and scholarship and research [9].

The retrieval and provision of drug information relies on different types of resources. The availability of advanced technology and mobile devices has greatly affected how drug information is retrieved. While tertiary drug information resources are available in both print and electronic forms, the majority of students prefer using electronic resources [13]. The convenience of use, remote access availability, and enhanced searching capabilities have been cited for these preferences [14]. In addition, online drug databases tend to be faster and more convenient than general online search engines for retrieving drug information [3]. Stolte et al. found that students' use of textbook resources declines as they progress in the pharmacy program [15]. However, if a student is required to read an entire book or long passage, print resources are usually preferred [14]. Currently, there is inadequate data assessing whether a student's age plays a significant role in their resource selection [15]. From a gender perspective, females are more likely to prefer active learning and verbal learning styles compared to their male counterparts [16,17].

Scott et al. found that students in their fourth professional year (P4) of pharmacy school were more confident in their communication skills and literature researching skills compared to those students in their first professional year (P1) [11]. These data imply that resource utilization may change as students advance in the pharmacy curriculum. Hanrahan et al. surveyed students and faculty at a single School of Pharmacy and determined tertiary DI resource preferences based on a small list of resources (e.g. Lexicomp®, Micromedex®, Facts and Comparisons®). Hughes et al. surveyed medical residents on different drug information resources [18].

There is limited data on how students' age, academic rank, and type of drug information question influences students' selection of tertiary drug information resources. There is also limited information on students' preferences for resources based on the type of question (e.g. dosing vs. indication) [13]. More data needs to be obtained on a larger number of electronic resources across different settings [13].

Objective: To evaluate the effects of age, gender, year in professional program, and type of drug information question on student pharmacists' selection of tertiary drug information resources.

2. METHODS

A prospective, cross-sectional survey was developed to assess pharmacy students' utilization of tertiary DI resources by age, gender, and year in professional program. The study was approved by the University of the Sciences Institutional Review Board. There was no internal or external funding obtained.

2.1 Selection Criteria & Setting

The setting for this study included two schools of pharmacy in the United States. Participants were eligible for the study if they were a full time pharmacy student enrolled in one of the two institutions surveyed. All students enrolled in the P1-P4 professional years during the Fall of 2015 at The Philadelphia College of Pharmacy (PCP) at University of the Sciences, Philadelphia, Pennsylvania and The Bernard J Dunn School of Pharmacy at Shenandoah University, Winchester, Virginia were eligible to participate in this study. An email communication with study background and request for participation was sent to the department chairs at both schools of pharmacy. The department chairs forwarded the initial survey link to all professional year 1 through 4 students currently enrolled at the pharmacy program with a reminder email sent two weeks later. Students were given one month to complete the survey. Consent to participate was built into the survey link. Study participation was optional and individuals were not provided any direct incentives for participating.

2.2 Survey Tool

An 8-question cross-sectional survey was designed to evaluate factors that influence pharmacy students' selection of tertiary drug information resources. The survey was developed using the software Qualtrics® and contained questions pertaining to the selection of specific tertiary DI resources used most often for a variety of DI topics. This survey was anonymous and confidential and was approved by the PCP PharmD Program Executive Committee (PPEC) to ensure that students' identities were protected.

A standard five-answer response scale, ranging from never to always, was used to assess the frequency of DI resource utilization and the frequency of electronic and paper-based resource utilization. An "other" category was built into the survey to account for resources not in the survey. Table 1 shows the topics and resources that were used in the survey. Individuals were further asked to identify if they preferred paper or electronic resources when using drug information resources. Demographic based questions detailing the individual's gender, year in professional program, and age were captured at the end of the survey.

2.3 Statistical Methods

The study was designed to achieve an 80% power to determine the differences between all endpoints. A sample size of at least 255 partial respondents was needed to achieve the desired power. Power calculations were based on the projected response ratio of electronic: print resource use. This sample size was similar to a previously published study [13]. The alpha (α) value was set prior to conducting the study at α = 0.05, and a p value of <0.05 was deemed to be statistically significant. A 95% confidence interval was used in this study.

Descriptive statistics were evaluated using frequency tables for the question involving the selection of DI resources based on topic. Frequencies were calculated and converted to percentages. Total usage of resources was calculated as: the sum of all the selections of a resource for the sixteen topics, divided by the total number of individuals combined for those topics. Mean differences were calculated by subtracting the absolute values of the two averaged scaled scores (scores ranged from 1-5 with never = 1 and always = 5). Differences between groups were calculated using ANOVA. An ANOVA was also used to calculate the use of DI resources by age groups. A Bonferroni correction was applied to both ANOVA analyses and results are reported accordingly. A Chi-square test (and when applicable a Fischer's

Exact test) was used to assess the difference between paper and electronic resources based on gender. The t-test was used to compare DI resource frequency questions by gender. Descriptive and inferential analyses were conducted using Microsoft Excel® and SPSS®.

3. RESULTS

A total of 285 responses were received and 152 of those responses completed the survey in its entirety. The demographics of the survey participants are listed in Table 2. These demographics reflect a somewhat typical pharmacy school demographic breakdown in terms of age and gender [19].

Students in their P4 year utilized tertiary DI resources more frequently than students in their P1 and P2 year (p= <0.001, 0.001 respectively). Students in the P3 year utilized DI resources more frequently than those in the P1 year (p = 0.002, MD = 0.9345). These results are presented in Table 3.

There were no differences in the frequency of resource utilization between males and females surveyed (p=0.656, MD = 0.0652). As shown in Table 4, students less than 23 years old utilized DI resources less frequently than students between the ages of 23 and 27 (p=0.004, MD = 0.5443) and students greater than or equal to 28 years old (p=0.014, MD = 0.6327).

The between group differences for the frequency of use of DI resources varied significantly between age groups (p=0.002). This is shown in Table 4.

3.1 Electronic Vs. Paper Resources by Professional Year, Age and Gender

Frequency by professional year: P1 students utilized electronic resources less often than those in other professional years (p= <0.001

Table 1. The students were surveyed to determine the DI resource most used for each of the topics listed below. Students could select from the resources provided in the survey or they could choose to select "Others" and write in a response

Topic surveyed	Resources used in the survey
Patient Education	AHFS Drug Information®
Dosing Recommendations	Clinical Pharmacology®
Indication	Drug Facts & Comparisons®
Pregnancy Risks	Google™
Breastfeeding and Lactation Risks	LexiComp®
Pediatric Recommendations	Medscape®
Geriatric Recommendations	Up to Date®
Adverse Drug Reactions	Micromedex®
Drug Interactions	Other Category
OTC Recommendations	
IV Stability and Compatibility	
Mechanism of Action	
Generic/Brand Name	
Cost of the Medication	
Identifying Dosage Forms	
Storage Conditions	

Table 2. Demographics. The table below shows a breakdown of the demographics of the individuals surveyed who completed the survey in full

Professional Yearn = 152 (%)		Age group n=152 (%)		Gender n=152 (%)	
P1	7.3	< 23 yrs	28.0	Female	68
P2	34.2	23 – 27 yrs	55.3	Male	32
P3	28.9	≥ 28 yrs	16.7		
P4	29.6				

(P1 vs P2), <0.001 (P1 vs P3), <0.001 (P1 vs P4) respectively). Students in the P4 year had the highest mean score for electronic resource utilization. However, there were no statistically significant differences in the utilization of electronic resources between P2's and P3's (p=1.000), P2's and P4's (p=0.776), and P3's and P4's (p=1.000). Overall, the use of paper-based resources was low compared to electronic resources for students in all four professional years. There were no differences in the utilization of paper resources between the P2, P3, and P4 years.

Frequency by age: The use of paper or electronic resources did not differ significantly between age groups (Table 5). The frequency of electronic resource use was similar between students under 23 years old and students aged 23 to 27 years (p = 0.167, MD = 0.2350). Usage was also similar between students who were less than 23 years old and students who were greater than or equal to 28 years of age (p =0.166, MD =0.1620). Students that were 28 years old or older had the highest mean score for use of electronic resources.

The frequency of paper-based resource usage was similar between students <23 years old and those between 23 to 27 years (p=1.000, MD=0.1295). The results of students 23-27 years of age and students greater than or equal to 28 years of age were similar (p=1.000, MD =0.1842).

Table 3. Frequency of DI resource use compared by professional year. The table below shows the differences between students based on their professional year in the curriculum. Significant p-values are bolded. The left column professional year is compared to the intersecting professional year from the top row. [X] Represents class comparisons between themselves and [–] is represented previously as the inverse. MD = Mean Difference

Professional Year $\alpha = 0.05$	**P1**	**P2**	**P3**	**P4**
P1	X	-	-	-
P2	**p = 0.123** MD = 0.5874	X	-	-
P3	**p = 0.002** MD = 0.9345	**p = 0.164** MD = 0.3470	X	-
P4	**p<0.001** MD =1.1960	**p = 0.001** MD = 0.6085	**p = 0.640** MD = 0.2615	X

Table 4. Frequency of DI resource use compared by age group. Significant p-values are bolded. The left column age group is compared to the intersecting age group from the top row. [X] represents class comparisons between themselves and [–] is represented previously as the inverse

Age Groups (years) $\alpha = 0.05$	**< 23**	**23 – 27**	**≥ 28**
< 23	X	-	-
23 – 27	**p = 0.004** MD = 0.5443	X	-
≥ 28	**p = 0.014** MD = 0.6327	**p = 1.000** MD = 0.0884	X

Table 5. Frequency of use differences between age groups for DI resources. Significant p-values are bolded

Between Groups Age Differences	**p-value**
Frequency of use	**0.002**
Frequency of use for electronic resources	0.086
Frequency of use for paper-based resources	0.653

Frequency by gender: There were no differences in the frequency of use of electronic (p=0.933, MD =0.009) or paper-based resources (p=0.099, MD = 0.2170) based on gender. Also, gender did not result in a significant difference in student preference for electronic or paper-based resources (p=0.688).

3.2 Frequency of Use by Topic

LexiComp® was the most frequently selected resource for 14 of the 16 drug information topics surveyed and was selected at least 20% of the time for all 16 topics (Table 6). Google™ was utilized most often for generic/brand names.

Whereas Micromedex® was used primarily for intravenous stability/compatibility. Both Micromedex® and Clinical Pharmacology® were extensively utilized for the majority of the topics assessed. The resources Up to Date® and Medscape® were less frequently utilized. Up to Date® was used > 2% of the time for only one topic (indications). Medscape® was not used >2% of the time for any topic.

3.3 Total Usage of DI Resources

Total usage of DI resources differed by year in professional school, and is shown in Fig. 1. The usage of LexiComp® and Micromedex® differed across all of the professional years. The total usage of LexiComp® was low in the P1 year and increased with progression in the curriculum. Micromedex® utilization was higher during the P1 year and declined throughout the professional years. Total usage of Google™ peaked to 12.5% in the P3 year. Clinical Pharmacology's® total usage peaked in the P2 year (18.73%), but was utilized less than 10% in all other years.

4. DISCUSSION

The results from our study demonstrate that the frequency of tertiary drug information resource utilization increases with age and progression through the professional year of pharmacy school.

Age had a significant effect on frequency of DI resource utilization in our study. Students 28 years of age or older had the highest mean score out of all the age groups.

Students in their P4 year had the highest mean score for frequency of DI resource usage amongst all professional years. There were significant differences between students in their P1 and P2 year compared to those in their P4 year. As students advance through the professional curriculum, they learn to apply and value the literature more and consequently

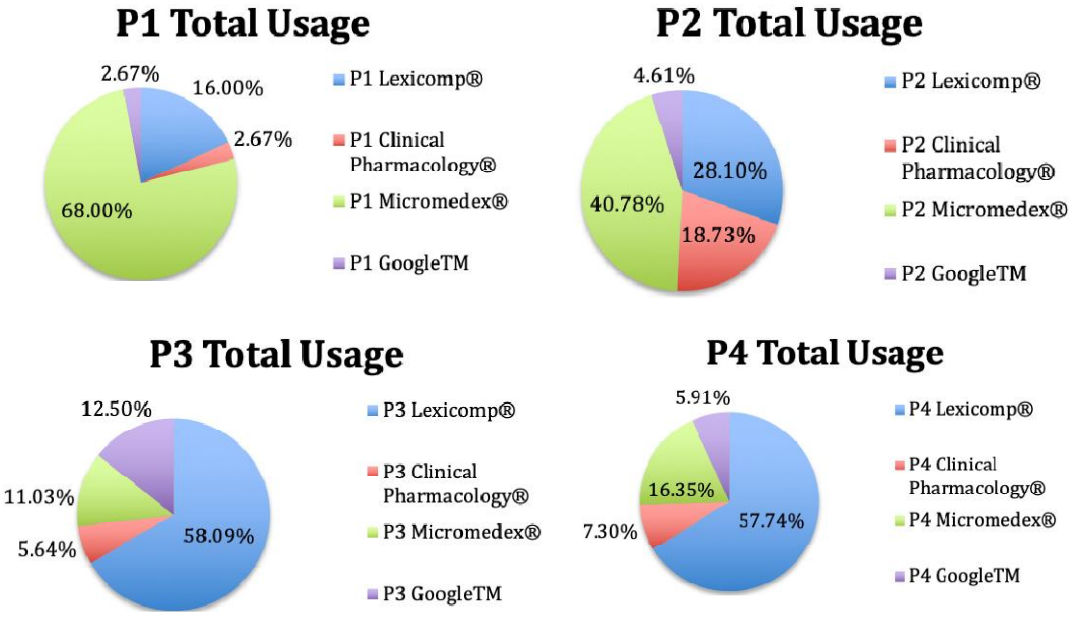

Fig. 1. Total usage for all topics by resource. Total usage for 4 of the resources assessed are presented by professional year. LexiComp® and Micromedex® change dramatically from the P1 to P4 year

Table 6. Frequency of DI resource use by topic. The percentage of students who selected each resource for each topic listed is provided. Darker cells indicate higher usage. OTC: Over the counter. ADRs: Adverse Drug Reactions

Topic	AHFS Drug Information® (%)	Clinical Pharmacology® (%)	Drug Facts & Comparisons® (%)	Google™ (%)	LexiComp® (%)	Medscape® (%)	Micromedex® (%)	Up To Date® (%)	Others (%)
Patient Education	0.7	9.9	0.0	4.6	33.6	0.7	25.0	0.7	0.7
Dosing	0.0	7.2	0.0	0.7	45.5	2.0	19.1	1.3	0.0
Indication	0.0	9.2	0.0	0.7	32.2	1.3	19.7	7.2	2.0
Pregnancy Risk	0.7	9.9	0.0	0.7	36.8	1.3	12.5	0.7	3.9
Breastfeeding/Lactation	0.0	9.2	0.0	1.3	37.5	0.7	17.8	0.7	2.6
Pediatrics	0.7	9.2	0.0	0.7	35.5	0.7	2.6	0.7	3.9
Geriatrics	0.0	10.5	0.0	0.7	36.2	0.7	3.9	2.0	2.0
ADRs	0.7	11.8	0.0	1.3	30.9	1.3	20.4	0.7	0.7
Drug Interactions	0.0	7.2	0.0	0.7	37.5	1.3	19.7	0.7	0.0
OTC	1.3	6.6	0.0	11.2	22.4	2.0	11.2	2.0	9.9
IV Stability & Compatibility	0.0	5.3	0.0	1.3	26.3	0.0	34.2	0.0	2.0
MOA	0.7	17.1	0.0	7.2	22.4	2.0	19.1	0.7	1.3
Generic or Brand Names	0.7	5.9	0.0	26.3	20.4	2.0	13.2	0.7	2.0
Cost	1.3	2.0	0.0	15.1	21.7	0.0	19.1	0.7	9.9
Dosage Forms	0.0	5.9	0.0	2.6	34.2	0.7	23.7	0.0	1.3
Storage	1.3	4.6	0.0	2.0	38.2	0.0	18.4	0.7	4.6

may be more likely to seek guidance on appropriate therapy information from DI resources. Additionally, as students enhance their skills in knowledge application outside of the classroom, they seek out resources beyond what they have used in the classroom. A student in their P1 or P2 year is focused more on the basic sciences and might not have developed a sense of the full clinical picture and how to apply their knowledge [11].

P1 students used electronic DI resources the least and P4 students used electronic DI resources the most in this study. The differences may be accountable to a couple of different concepts. First, P4 students would most likely need resources that are available remotely during their experiential rotations in hospitals or clinics. Secondly, P1 students may lack knowledge about what electronic resources are available to them at this stage in their coursework. Students are often provided with required readings and textbooks to supplement their education early in the curriculum as opposed to later in their coursework when they are expected to retrieve information themselves. Additionally, our data supports the findings by Stolte et al, that the use of paper textbooks declines as students advance in the curriculum [13,15].

Google™ utilization increased in total usage during the P3 year compared to other professional years. The authors of this study expected the usage of Google™ to start high and decrease as students advanced in the curriculum. While Google™ still had relatively low usage (<10% all years except the P3 year) it still represents an interesting observation.

Another interesting note in regards to professional year is that students had very similar total usage scores in the P3 and P4 year, but between the P2 and P3 year, there was a large shift in the scores of the four primary resources (Fig. 1). This could reflect the educational differences between the P2 and P3 year. By the P3 year, students have been exposed to the majority of the professional curriculum and have a greater understanding of its clinical application. Their DI resource preferences may change based on the advancement of their overall knowledge and application of that knowledge. The total usage similarity between the P3 and P4 year might be due to the fact that students now become entrenched as they start using their skills in the real world. These results suggest that students' preferences do not change nearly as much after they complete their didactic coursework compared to while they are still in classroom. Therefore, students appear to become more resistant to change after completing their didactic coursework. This emphasizes the importance of educating students properly on appropriate use of DI resources before they go out into clinical practice and experientials. The inverse relationship between Micromedex® and LexiComp® utilization and professional year in school was unexpected. The total usage essentially flipped from the P1 year to the P4 year. This was a noteworthy finding, as it displays the dynamic changes that may occur with student preferences and learning styles over time.

5. CONCLUSION

The results of this study may be beneficial to pharmacy schools as it provides insights into the factors that influence student preference for tertiary drug information resources. This study found that age, year in school, and type of drug information request impacted students' use of tertiary DI resource preference. The authors did not find that gender had a significant role in usage of DI resources. Understanding choices of students could help elucidate what DI resources will be used by students in their professional practice. Ensuring accuracy of resources commonly used by students is paramount so that continued use of these resources after graduation provides the user with the most accurate information in clinical practice.

6. STUDY LIMITATIONS

A limitation of our study was that we limited our survey population to two schools of pharmacy. While our study surveyed more schools of pharmacy and included more DI resources than a previous study, it would be of benefit to expand the survey across multiple schools to help increase external validity [13]. In addition, understanding key attributes across and within each resource would be important to faculty and library personnel when selecting available resources.

7. IMPLICATIONS

There are two major avenues of application for this study. First, this information is valuable to schools of pharmacy when selecting resources for their students in their respective pharmacy

schools. These results can help pharmacy schools select DI resources if they are limited by budgetary restrictions to help create the best value for their students. Additionally, this information can help administrators choose resources that most students use and can also ensure that resources are provided that encompass a variety of topics. Only a few of the resources were used >10% of the time in total usage. This is valuable information to help select the best resources for students to use as they progress through the curriculum.

Secondly, despite the availability of numerous online databases, some of these databases contain errors. A recent study of 270 drug summaries from five online drug information compendia found errors due to information that was inaccurate, incomplete, or omitted [20]. This is significant, because it is almost impossible for healthcare professionals to monitor all of the DI resources available for accuracy. Therefore, it is important to know the current trends in drug information to help maintain the accuracy of the databases. This research provides an outline of which resources are used most frequently by students. These current students will become the pharmacists of the future, and our results suggest that students become less malleable as they advance in the curriculum. Therefore, it is likely that the resources being used by pharmacy students currently will become the resources they select as practicing professionals. Thus, it is imperative that these most commonly used resources are updated and provide accurate information, upon which these future pharmacists can base their recommendations to deliver optimal care for patients going forward. These results may be useful in guiding the selection of resources that need to be monitored on a more regular basis to ensure accuracy.

COMPETING INTERESTS

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly used products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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