

Evaluating the Impact of a University Pharmacy Vending Machine Program

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Abstract

This study assesses the impact and potential enhancements of a Pharmacy Vending Machine (PhVM) program implemented at Purdue University since January 2021. Aimed at addressing the accessibility gap for essential healthcare items, particularly sexual and reproductive health products, and over-the-counter medications, the program has expanded from two to eight PhVMs on campus. A Purdue University sample (n=469) completed a web-based survey to evaluate the program's efficacy and identify avenues for improvement. Survey responses and sales data from January 2021 to April 2023 were analyzed. Findings demonstrate a positive reception of the PhVMs, highlighting a preference for increased accessibility to sexual and reproductive healthcare items. Word of mouth remains a key source of awareness for vending machines, suggesting the significance of targeted marketing strategies and information dissemination within on-campus groups. Sales data trends underscore the necessity for ongoing assessment to optimize student access to PhVMs. This study is a comprehensive evaluation, emphasizing the importance of continual refinement in healthcare vending initiatives to cater effectively to campus community needs.

Keywords: pharmacy vending machine, sexual health, university pharmacy programs, healthcare accessibility, emergency contraception.

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Introduction

College campuses offer a variety of resources and services to students, including restaurants, bars, and stores. However, pharmacy items are often difficult to come by as there may be limited access to on-campus pharmacies, transportation, and financial support (Racine et al., 2022). Pharmacies are critical in promoting physical, mental, and sexual wellness on college campuses (Shirdel

et al., 2021). Despite efforts to improve accessibility, college students still face financial barriers when it comes to obtaining essential health items like over-the-counter (OTC) medicines and condoms (Abdullah et al., 2022). The rising costs of these items, coupled with issues related to insurance coverage, continue to hinder access for many students (AHRQ, 2021). Specifically among the college-aged demographic, emergency contraception (EC) is often utilized to protect

against unplanned pregnancy following unprotected sex, regular contraception misuse, and sexual assault (Demissie et al., 2020). Yet, EC, including Take Action, PlanB One-Step, and Julie, typically retail in stores between \$40 and \$60. The cost of EC burdens individuals, further increasing the disparity between health and socioeconomic status (Mowreader, 2023). Studies have shown a lack of accessibility to OTC items impacts school attendance, academic performance, and individual health (Rattermann et al., 2021). Incorporating pharmacy vending machines (PhVM) offers

a solution to further support healthcare accessibility (DeMaria et al., 2023).

Across the nation, universities have developed programs to address these barriers to accessing healthcare products and supplies by creating PhVM programs (DeMaria et al., 2023; Santos, 2023). Pharmacy vending machines are a great way to supply various healthcare products to students because they are easy to use, and most have previous experience purchasing from a vending machine (Jairoun et al., 2022; Md Mansor et al., 2018). As a result, the vending machine offers a convenient solution to increasing

Figure 1: Pharmacy Vending Machine



healthcare accessibility for college campuses by offering OTC and sexual health items (DeMaria et al., 2023; Mowreader, 2023). In addition to their familiar design, students benefit from access to the products they need in a nonpublic setting. PhVM programs offer a solution to purchase embarrassment as they eliminate interpersonal interaction when purchasing sensitive products (DeMaria et al., 2020).

The Purdue University PhVM program was created in January of 2021, providing students 24/7 access to various healthcare products, including family planning items (e.g., condoms and EC), pharmaceutical cold/flu remedies, COVID-19 tests, and menstrual health items (Figure 1). As of August 2022, eight PhVMs are on campus, resulting from three implementations: two machines in January 2021, two more in September 2021, and four in September 2022. The success and growth of the program are attributable to the partnership with the university pharmacy and procurement services, as they provide stock for PhVMs at affordable prices and track the sales of each item. For example, emergency contraception is offered in PhVMs for \$13.50 because the campus pharmacy can purchase the generic option at a wholesale price, which is typically significantly cheaper than brand-name medications (*Costs of Drugs in Infectious Diseases: Branded, Generics, and Why We Should Care* | *The Journal of Infectious Diseases* | Oxford Academic, n.d.). This approach allows the program to offer essential products at affordable prices, which can promote student health and well-being. Tracking sales data has been critical, emphasizing the desire for PhVM items on our university campus. Additionally, the strategic locations (public and private) for the machines within larger academic, residential, and recreational buildings lead to increased accessibility and convenience for consumers (DeMaria et al., 2023). Yet, continued

program development and evaluation are necessary to increase healthcare accessibility through PhVM implementation. This study aimed to evaluate Purdue University's PhVM program from the process through impact.

Methods

This research study investigated how eight pharmacy vending machines have improved consumer access to affordable personal care items such as family planning and sexual health products, COVID-19 testing kits, and OTC medications on a university-based campus. This study was approved by Purdue University's Institutional Review Board (IRB-2022-1196).

Survey

Qualtrics, a web-based survey platform, was used to collect relevant data on the awareness and use of the PhVMs and aimed to identify and understand the consumers' product preferences and satisfaction. The survey was emailed to a sample of undergraduate, graduate, and professional students (n=5,000) curated by Purdue University's Institutional Data Analytics and Assessment Office. Random sampling was used as all university-affiliated students have an equal chance to be selected. Survey questions (n=26) aimed to measure the current use, history of use, and awareness of the PhVMs on the college campus. All questions were recorded as multiple-choice, fill-in-the-blank, and "Select all that apply." Additional distribution occurred through social media platforms such as Instagram, Facebook, and GroupMe. After completing the survey, ten random participants were selected for a \$20 Amazon gift card.

Participants and Procedures

Eligible participants were university-affiliated students who were at least 18 years old. Participants were initially asked about their demographics, including their age, gender, sexuality, living situation, and university classifications (i.e., undergraduate vs graduate). Additionally, participants answered questions on program awareness,

reasons behind machine usage, and opinions on available products. All participants were able to leave feedback on recommendations for future changes in the vending machines regarding product type and machine location. Measurement tools and data are available upon request.

Table 1: Participant Characteristics

Characteristic	N (%) or Mean±SD
Sample size	469
Age (years)	20.85±3.19
Gender	
Woman (cis or transgender)	331 (70.6)
Man (cis or transgender)	123 (26.2)
Non-binary	7 (1.5)
Gender queer or Gender nonconforming	2 (0.4)
I Prefer Not to Answer	6 (1.3)
Sexuality	
Heterosexual or Straight	367 (78.3)
Bisexual	58 (12.4)
Gay or Lesbian	11 (2.4)
Queer	9 (1.9)
Pansexual	6 (1.3)
Asexual	3 (0.6)
Unsure	9 (1.9)
I Prefer Not to Answer	6 (1.3)
University Classification	
Undergraduate Student	426 (90.8)
Graduate/Professional Student	42 (8.9)
Academic Standing (Undergraduates Only)	
Freshman	29 (6.2)
Sophomore	153 (32.6)
Junior	133 (28.4)
Senior	111 (23.7)
Living Situation	
Off-campus Housing	230 (49)
Residence Halls	116 (24.7)
On-campus Housing	54 (11.5)
Fraternity/Sorority/Co-Op Housing	50 (10.7)
I Do Not Live in West Lafayette/Lafayette	19 (4.1)
<i>Note: Items that do not add to 100% reflect missing data.</i>	

Data Analysis

Data analyses were led by a graduate student with four years of mixed-methods research experience and supported by four interdisciplinary undergraduate students. The process was closely overseen by a professor of public health specializing in reproductive health research as part of a research credit learning experience. Descriptive statistics gave insight into the attitudes and use behaviors toward PhVMs. These statistics included frequencies and percentages for categorical variables. IBM SPSS 29.0.0.0 (241) was used to analyze the data and observe patterns to capture consumer experiences.

Sales Data

Since implementation, each item offered through the PhVMs has been tracked. As the

survey captured people's thoughts and actions regarding the PhVMs, the sales data was reported further to supplement their understanding of user preferences and purchasing habits. This combined data set gave a more holistic view of PhVM program engagement. The sales data was not used as a measure in the survey.

Results

Research Participants

The survey collected complete responses from 469 participants at Purdue University. The participants' average age was 20.85 ± 3.19 . The majority identified as undergraduate students ($n=426$, 90.8%), with a large representation of women (cis- or transgender) ($n=331$, 70.6%). Participants provided information on their classification (e.g., undergraduate, graduate, professional),

Table 2: Total Items Sold per a Pharmacy Vending Machine Location

Total Items Sold per PhVM				
PhVM Location	Implementation I March - August 2021	Implementation II Sept 2021 - August 2022	Implementation III Sept 2022 - April 2023	Total
WALC	411	1624	1049	3084
COREC	280	1331	1022	2633
HILL	-	1227	1634	2861
FORD	-	1024	1109	2133
STEW	-	-	992	992
LILY	-	-	513	513
BRNG	-	-	485	485
ERHT	-	-	1183	1183
Total items:	691	5206	7987	13884

Note: Missing data for a PhVM location indicates the machine in that location was not yet implemented.

WALC = Wilmeth Active Learning Center, Main campus library

COREC = France A. Córdoba Recreational Sports Center, campus rec center

HILL, FORD, ERHT = Residential dining courts

LILY, BRNG, STEW = Academic buildings

academic standing (e.g., freshman, sophomore, junior, senior), and living situation (e.g., on-campus vs off-campus). Overall, more students lived off-campus (n=249, 53.1%) than on-campus (n=220, 46.9%), and the majority of off-campus residents were undergraduates (n=208,

83.5%). See *Table 1* for a detailed breakdown of participant characteristics.

Table 3: Total Sales per Item

	Implementation I	Implementation II	Implementation III	Total
PhVM Items	March 2021 – August 2021	September 2021 – August 2022	September 2022 – April 2023	2021–2023
EContra One-Step 1.5 Mg Tablet	235	2225	2423	4883
Covid Test	0	30	2059	2089
Kotex	45	402	924	1371
Tampon	53	482	728	1263
Trojan Cm 3 Regular	29	348	428	805
Cough Drops 7.5Mg	17	192	198	407
Daytime Cold-flu Relief Softgel	5	155	223	383
Carmex Click Stick ST	12	114	173	299
Acetaminophen 500Mg Tablet	13	103	154	270
TUMS smoothies chew tablet	16	107	87	210
Ibuprofen 200 Mg Caplet	66	141	0	207
Kleenex pock.	11	81	111	203
H-R Lubricating Jelly	8	47	73	128
Loperamide 2Mg Caplet	12	54	61	127
Clearblue Flip Click Pregnancy Test	54	46	27	127
Hydrocortisone 1% cream	5	46	68	119
Flexible Fabric Ap8 Travel Band-Aid	22	90	6	118
Loratadine 10MG Tablet	12	41	49	102
Banophen 25 Mg Tablet	1	42	57	100
Urinary Pain Relief 99.5 MG Tb	6	51	41	98
Nasal Decongestant Spray 0.05%	4	76	4	84
Triple Antibiotic Ointment	1	53	25	79
Motion Sickness 50MG Tablet	7	31	22	60
Miconazole 7 Cream	14	23	20	57
Bismatrol Tablet Chew	11	46	0	57
Gas Relief 125 Mg softgel	2	25	14	41
Icy Hot CR 1.25oz tube	1	35	0	36
Secret Solid St 1.7oz	11	15	0	26
Listerine MW 3.2oz cool mint	4	22	0	26
Artificial tear drops	1	18	4	23
No Rinse Bathing Wipes Pack 8ct	3	13	4	20
Dairy Aid	4	13	3	20
Crest Complete Tpst/Tbrsh Trsz	4	14	0	18
Brut	2	15	0	17
Allavo Hand Sanitizer Gl 70% 59ml	0	10	1	11
Total	691	5206	7987	13884

Awareness and Use of Pharmacy Vending Machines

Awareness: PhVMs were promoted using various channels, including campus-based news platforms, social media, and flyers. Participants learned about the vending machines mainly through word-of-mouth (n=213, 45.4%), email (n=85, 18.1%), social media (n=74, 15.8%), and in-class announcements (n=54, 11.5%).

Purchase Trends: Since implementation, 13,884 items were sold, showing incremental increases in sales (n=691, 4.98%; n=5206, 37.50%; n=7987, 57.53%) across different periods. The machines with the highest sales were WALC^a (n=3084, 22.21%), HILL^b (n=2861, 20.61%), COREC^c (n=2633, 18.96%), and FORD^d (n=2133, 15.36%). Top-selling items included EContra One-Step (EC) (n=4883, 35.17%), Abbot Covid-19 testing kits (n=2089, 15.05%), Kotex pads (n=1371, 9.87%), Tampax tampons (n=1263, 9.10%), and Trojan condoms (n=805, 5.80%). Conversely, low consumption was observed for items like hand sanitizer (n=11, 0.08%), deodorant (n=17, 0.12%), toothbrushes (n=18, 0.13%), dairy aid (n=20, 0.14%), and bathing wipes (n=20, 0.14%). *Table 2* illustrates the total sales per PhVM location over three implementations (March 2021 to April 2023), while *Table 3* presents the total sales per item and provides a comprehensive overview of the sales performance of each item over the specified time frames and implementations.

Usage Patterns and Purchase Intentions Based on Campus Residence: On-campus students primarily used the machines for personal (n=54, 11.5%), partner (n=20, 4.1%), and friend (n=20, 4.3%) needs. The most frequented on-campus locations were a popular dining court (n=133, 28.4%), the

campus recreational center (n=132, 28.1%), and the main campus library (n=130, 25.6%). A notable portion of on-campus students (n=160, 72.7%) had not yet made a purchase, with varying responses on the likelihood of future usage (n=66, 41.3% extremely/somewhat likely; n=55, 34.4% extremely/somewhat unlikely). Conversely, most students who had used the machine before (n=58, 26.4%) expressed an intention to repurchase (n=50, 86.2%).

Off-campus students (n=197, 42.0%) tended to purchase PhVM items on campus rather than travel to the machines. Frequently noticed locations for off-campus students were the recreational center (n=139, 29.6%) and the main library (n=133, 28.4%). However, many off-campus students (n=176, 37.5%) reported never purchasing from a PhVM. Among them, opinions on the likelihood of future usage varied (n=61, 34.7% extremely/somewhat likely; n=74, 42.0% extremely/somewhat unlikely). See *Table 4* for further comparison between on-campus and off-campus students.

Participant Appreciation, Product Preferences, and Program Recommendations

Survey participants appreciated several aspects of the vending machines, particularly emphasizing convenience (n=400, 85.3%), affordability (n=248, 52.9%), location (n=243, 51.8%), and the availability of sexual and reproductive health care items (n=225, 48%). Participants expressed preferences for additional sexual and reproductive health items already available, including EC (n=215, 45.8%), pregnancy tests (n=172, 36.7%), condoms (n=143, 30.5%), and menstrual products (n=141, 30.1%). Other noted products included ibuprofen (n=160,

^a Wilmeth Active Learning Center: main campus library

^b Hillenbrand Residence and Dining Hall

^c France A. Córdova Recreational Sports Center: campus recreation center

^d Ford Dining Hall

34.1%), cold and flu medication (n=140, 29.9%), band-aids (n=118, 25.2%), deodorant (n=115, 24.5%), and cough drops (n=115, 24.5%). A small percentage of participants desired fewer offered products, with requests for less lubricating jelly (n=33, 7.0%), EC (n=23, 4.9%), condoms (n=16, 3.4%), hand sanitizer (n=15, 3.2%), and Kleenex (n=12, 2.6%). Suggestions for new

products included vitamin C powder (n=182, 38.8%), vitamins (n=142, 30.3%), menstrual cups (n=141, 30.1%), sleep aids (n=125, 26.7%), and Narcan (n=115, 24.5%). Most students expressed contentment with the existing product range (n=327, 69.7%).

Table 4: PhVM Usage in On-Campus vs Off-Campus Students

Sample Size	N=469	
	On-Campus Students (n=220)	Off-Campus Students (n=249)
PhVMs Seen on Campus		
COREC	132 (28.1)	139 (29.6)
WALC	129 (25.6)	133 (28.4)
Hillenbrand Dorm/Dining Hall	89 (19.0)	36 (7.7)
Ford Dining Hall	133 (28.4)	42 (9.0)
Earhart Dorm/Dining Hall	38 (8.1)	15 (3.2)
Lily Hall of Biological Sciences	34 (7.2)	39 (8.3)
Beering	35 (7.5)	46 (9.8)
Stewart/HIKS	47 (10.0)	45 (9.6)
I have not seen the PhVMs	9 (1.9)	43 (9.2)
I do not remember	4 (0.9)	11 (2.3)
PhVMs Purchased From		
COREC	20 (4.3)	37 (7.9)
WALC	24 (5.1)	34 (7.2)
Hillenbrand Dorm/Dining Hall	16 (3.4)	7 (1.5)
Ford Dining Hall	15 (3.2)	8 (1.7)
Earhart Dorm/Dining Hall	2 (0.4)	0 (0.0)
Lily Hall of Biological Sciences	2 (0.4)	2 (0.4)
Beering	1 (0.2)	3 (0.6)
Stewart/HIKS	2 (0.4)	4 (0.9)
I have not purchased from the PhVMs	160 (34.1)	176 (37.5)
I do not remember	4 (0.9)	4 (0.9)
Items are presented as n (%) or Mean±SD. Items that do not add up to 100% reflect missing data.		

WALC = Wilmeth Active Learning Center, Main campus library
 COREC = France A. Córdoba Recreational Sports Center, campus rec center
 HILL, FORD, ERHT = Residential dining courts
 LILY, Beering, STEW, HIKS = Academic buildings

Discussion

Our study evaluated the impact of the Purdue University PhVM program and identified areas for improvement, providing insights into crucial aspects of student access to healthcare products. The findings offer valuable information on usage patterns, preferences, and perceptions among the diverse participant base.

Findings indicated that the strategic placement of PhVMs, particularly in high-traffic areas like the campus recreational center and main library, contributed to widespread awareness, aligning with previous vending machine-related work (Allen et al., 2022). The convenience of these locations played a pivotal role in the machines' success. Moreover, the study identified word-of-mouth as the primary source of awareness. To add to the discussion, targeted awareness campaigns through social media, flyers, and peer education were used to achieve greater engagement. Campus organizations played a crucial role in disseminating information, requiring media support to facilitate effective communication.

A noteworthy observation was that off-campus students expressed reluctance to use PhVMs if they had not done so before. Possible explanations included the perceived inconvenience of machine locations or a lack of immediate need, aligning with past work exploring the needs of off-campus students (Lederer & Wetzell, 2014). To address this, a relocation strategy for underperforming machines was suggested to serve the off-campus population better. Potential locations included academic buildings near bars, popular restaurants, and gameday parking areas. The correlation between previous usage and future intent indicated that overcoming initial barriers, such as embarrassment or unfamiliarity, fostered comfort and likelihood of future use. As past

work suggested, this underscored the importance of understanding psychological factors influencing students' engagement with PhVMs (DeMaria et al., 2020; Ramos-Ortiz et al., 2020).

Past research studying food and beverage vending on college campuses noted that students generally appreciated the convenience, affordability, and accessibility of PhVMs (Sowers et al., 2019). Notably, the success of EC in sales highlighted the significance of offering affordable family planning options, especially amid increasing restrictions on abortion (Cleland et al., 2022; Stein et al., 2022; Wagner & Cleland, 2023). The study identified key product preferences, emphasizing the demand for sexual health items, OTC products, and novel items like vitamins and menstrual cups. This information was valuable for program enhancement and adapting to the evolving needs of the student population.

The success and growth of the Purdue University PhVM program showcased the importance of strategic partnerships, affordable pricing, and careful stock tracking. Continuous evaluation of sales data remained critical for program development, ensuring alignment with the evolving needs of the student community. As the study concluded, ongoing program development and evaluation were crucial for sustaining and expanding the impact of the PhVM initiative. Our case study provides valuable insights for other institutions looking to enhance healthcare accessibility through similar programs.

Strengths & Limitations

The campus-wide survey gave holistic insight into the demographic of those who use the PhVMs and the benefits offered to students. The interdisciplinary research team, comprised of one graduate student and several undergraduates, possessed varying

amounts of graduate-level methodology training. While many strengths are associated with this paper, several limitations need to be highlighted. One limitation of our study is the potential for sampling bias, as the sample was drawn exclusively from university-affiliated students, possibly excluding perspectives from non-affiliated individuals. When analyzing the diversity of survey participants, there is a lack of male representation in responses. As of 2022, the campus demographics of Purdue University are 57% male to 43% female students (*Here's What Student Life Is Like At Purdue University—Main Campus*, n.d.). This statistic further emphasizes the need for a greater understanding of male behavior towards the PhVM program, as they comprise the greater portion of campus students. To combat these limitations, understanding the health needs of the male population is necessary to enrich the usage of the PhVMs and improve marketing techniques to spark a higher response and diversity of opinion.

An additional shortcoming is that product tracking may have discrepancies due to inconsistent counting, a shortage of products due to selling out, or supply chain shortages. Lastly, inconsistencies in the survey were found after dissemination, where a comparison of knowledge, use, and awareness of the pharmacies on-campus and off-campus students could be made. This set of questions was marginal and ultimately excluded from the data analysis when comparing on-campus versus off-campus student trends. While a direct comparison could not be made, valuable information was still gathered from both demographics. Despite these limitations, our findings contribute to the literature by addressing the healthcare accessibility challenges college students face. Limited access to pharmacies, financial barriers, and the need for discreet purchasing options were highlighted issues. The PhVM program emerged as a practical

solution, aligning with national trends where universities implemented similar initiatives to enhance campus healthcare accessibility.

Implications For Health Behavior Research

This research highlights the importance of understanding how college students access healthcare products, particularly emphasizing sexual and reproductive health items like condoms, emergency contraceptives, and menstrual products. Building upon previous work (DeMaria et al., 2023), our findings further explore the nuanced factors influencing student utilization of these services. Recognizing the barriers, including proximity and cost, is crucial for designing programs tailored to campus-based populations' needs. Strategic placement and targeted marketing of PhVMs can serve as effective tools for campus organizations and educators in promoting public health campaigns to address these issues. By breaking down taboos and promoting open dialogue, such initiatives contribute to students' overall well-being. PhVMs offer a private, affordable, and reliable avenue for students, regardless of their level of sexual health education or ideologies, to access vital sexual health and over-the-counter products. This holistic approach to understanding and addressing healthcare access among college students contributes to ongoing efforts in health behavior research, facilitating the development of effective strategies to promote wellness within educational settings.

Conclusion

Our study suggests strategic placement and marketing campaigns around the PhVMs are pivotal in driving widespread usage and promotion, particularly in high-traffic areas like the campus recreational center and main

library. To better serve off-campus students, our findings recommended a relocation strategy for underperforming machines, emphasizing the importance of overcoming initial barriers of usage. Participants greatly appreciated the program's convenience, affordability, and accessibility, contributing significantly to its success. Purdue University's PhVM program holds a valuable blueprint for other institutions seeking to enhance healthcare accessibility through similar initiatives. Our study sheds light on key factors influencing the success of PhVM programs and their potential impact on healthcare accessibility in campus environments.

Discussion Questions

The findings of this study demonstrated that student feedback is vital in the acceptance and continued evaluation of public health campaigns. What plausible methods could schools implement to continue to grow and evaluate a pharmacy vending machine program without oversaturating the population? As information about the PhVM program was spread by word of mouth, what social media campaigns and/or online presence should a future program plan have?

This study had many strengths, but a primary limitation was the need for more male survey participants. How could pharmacy vending machine messaging and products better combat misinformation and target those with various gender identities? Would partnerships with LGBTQ+, athletic, and women's health organizations lead to increased recognition and trust for the program?

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