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Research and Applications

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Feasibility of a contraceptive-specific electronic health record system to promote the adoption of pharmacist-prescribed contraceptive services in community pharmacies in the United States

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Abstract

Objectives: Pharmacists in over half of the United States can prescribe contraceptives; however, low pharmacist adoption has impeded the full realization of potential public health benefits. Many barriers to adoption may be addressed by leveraging an electronic health records (EHR) system with clinical decision support tools and workflow automation. We conducted a feasibility study to determine if utilizing a contraceptive-specific EHR could improve potential barriers to the implementation of pharmacist-prescribed contraceptive services.

Materials and Methods: 20 pharmacists each performed two standardized patient encounter simulations: one on the EHR and one on the current standard of care paper-based workflow. A crossover study design was utilized, with each pharmacist performing encounters on both standardized patients with the modality order randomized. Encounters were timed, contraceptive outputs were recorded, and the pharmacists completed externally validated workload and usability surveys after each encounter, and a Perception, Attitude, and Satisfaction survey created by the research team after the final encounter.

Results: Pharmacists were more likely to identify contraceptive ineligibility using the EHR-based workflow compared to the paper workflow ($P = .003$). Contraceptive encounter time was not significantly different between the 2 modalities ($P = .280$). Pharmacists reported lower mental demand ($P = .003$) and greater perceived usefulness ($P = .029$) with the EHR-based workflow compared to the paper modality.

Discussion and Conclusion: Pharmacist performance and acceptance of contraceptive services delivery were improved with the EHR workflow. Pharmacist-specific contraceptive EHR workflows show potential to improve pharmacist adoption and provision of appropriate contraceptive care.

Lay Summary

Almost half of pregnancies in the United States are considered unintended. Unintended, particularly unwanted pregnancies can result in poor health and economic outcomes, especially among underserved populations. Improving access to the full range of contraceptive methods is a key solution to improving health outcomes. One promising approach is pharmacist contraceptive prescribing. Over half of the United States allow pharmacists to provide these services, but the utilization remains low. Pharmacists currently perform these services on paper forms, which can be time-consuming and hard to incorporate into their already busy schedules. This study examines whether an Electronic Health Records system designed specifically for contraceptive services could make it easier for pharmacists to provide these services. Twenty pharmacists performed two standardized patient encounters, one on the paper form and the other on the Electronic Health Record system. The encounters were timed, contraceptive choices were recorded, and the pharmacists took surveys to evaluate workload, usability, perception, attitude, and satisfaction of each option. The Electronic Health Record system improved contraceptive selection safety guideline compliance, lowered mental demand, had higher perceived usefulness scores, and was generally preferred by pharmacists, but did not significantly decrease the time to needed to complete a contraceptive encounter.

Key words: contraception; pharmacists; family planning services; decision support systems, clinical; digital health.

Introduction

Background and significance

The unintended pregnancy rate in the United States (US) remains high compared to other nations with high-income economies at 45%.[1] Unintended pregnancy leads to health and economic disparities, disproportionately affecting younger, minority, and lower-income women.[1,2] Additionally, unintended pregnancy financially burdens society, with US expenditures on medical care from unintended pregnancy totaling $21 billion in 2010 alone.[3] Of individuals with an unintended pregnancy, around 95% occur among those who

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use contraceptives inconsistently or not at all.[4] A nationally representative survey of women at risk of unintended pregnancy in 2011 found that nearly one-third of adult women reported having problems obtaining a contraceptive prescription or refill, with those who were uninsured, Spanish-speaking, and less educated significantly more likely to report difficulty.[5]

According to the Guttmacher Institute, the number of adult women with incomes below 250% of the federal poverty level who need public-funded contraceptive services in the US increased by 25% between 2000 and 2016.[6] In 2015, only 42.9% of women that needed publicly funded contraceptive services and supplies received them.[7] In addition, access to contraceptive services significantly decreased following the 2019 Title X "gag rule," leaving many additional women without access to confidential family planning care.[8,9] More than 19 million women live in a county without a single health center offering the full range of contraceptive services,[10] while 90% of the US population lives within at least 5 miles of a pharmacy.[11] This creates the opportunity for pharmacist-prescribed contraceptive services (PPCSs) to increase access to care, decrease health inequities, and combat the high unintended pregnancy rate in the US.

Twenty-eight states and Washington D.C. currently allow pharmacists to prescribe contraceptives, and additional states have supportive legislation pending.[12] A recent national survey of community pharmacists revealed that 72% of pharmacists in states allowing PPCS stated that they were personally interested in prescribing hormonal contraception.[13] Despite the high interest, only 7.2% of the retail pharmacist workforce prescribed contraception in 2021, with state-level participation ranging from <1% to 13%.[14] Pharmacists cite time constraints, limited resources, corporate policies, lack of training, liability concerns, reimbursement challenges, and difficulty incorporating inefficient paper-based processes into daily practice as barriers to implementing PPCSs.[15–20] Most healthcare services in the US have been digitized, with over 87% of office-based physicians utilizing an electronic health records (EHR),[21] yet there remains no commercially available digital solution for PPCS's to address these current barriers to adoption.

To explore the feasibility of a contraceptive-specific EHR platform to support the adoption of PPCSs, members of the research team repurposed an existing EHR originally developed for contraceptive telehealth services. The software platform facilitates acquiring patient information, documenting encounters, and enhancing contraceptive decision-making with CDS tools including hard stops to ensure compliance with the Centers for Disease Control and Prevention's US Medical Eligibility Criteria (USMEC) guidelines. Additionally, the software suggests contraceptives based on the patient's prior hormonal contraceptive experience to help avoid poorly tolerated active pharmaceutical ingredients (APIs) and promote those that were previously well-tolerated.

This study compares a digitized workflow on the contraceptive-specific EHR platform to the current standard paper-based process to determine the feasibility of repurposing the platform for pharmacists to provide in-person contraceptive services in the pharmacy setting. The research team selected several outcome measures, including (1) encounter completion time, (2) contraceptive selection, (3) externally validated workload and usability surveys, and (4) a Perception, Attitude, and Satisfaction (PAS) survey to evaluate the effects of the 2 workflows on metrics related to successful process implementation.

Methods

Study design and population

We used a 2 × 2 crossover design framework to compare 2 "treatment" processes: the current standard of care paper-based workflow control and the contraceptive-specific EHR test arm. Twenty US-based pharmacists with active pharmacy licenses and patient care experience were recruited through social media. Each pharmacist completed two standardized contraceptive patient encounters in sequence (referred to here as Patient 1 and Patient 2). To minimize selection bias, an impartial third-party moderator used randomizer software (https://app.studyrandomizer.com) to assign each pharmacist a number between 1 and 20 and the 2 study arms were created by dividing the participants into odd and even groups according to the randomized number. Participants in the odd-numbered group began with the paper-based workflow, while those in even-numbered group began with the EHR workflow.

The paper-based documents and workflow utilized were the most recently approved Oregon Board of Pharmacy (BOP) standards, including the Oregon Self-Screening Risk Assessment Questionnaire (SSRAQ) and accompanying algorithm.[22] Oregon was the first to have a statewide PPCS protocol and has served as an example for subsequent states. Before study commencement, each enrolled pharmacist completed the Oregon BOP-approved contraceptive continuing education course, which includes training on contraceptive prescribing and the appropriate use of the Oregon paper forms and algorithm.

During the study, pharmacists engaged in simulated patient encounters guided by the Pharmacists' Patient Care Process (PPCP), which is recommended by the Joint Commission of Pharmacy Practitioners as the basis for all pharmacist clinical services, is a required element of pharmacist education, and is referred to in the contraceptive protocols.[23] Pharmacists were permitted to reference the USMEC chart and clinical pharmacy resources typically available in a pharmacy setting. The USMEC guidelines are widely recognized as the standard for contraceptive safety and form the basis for all state-specific BOP algorithms.[22,24,25]

The standardized patient information was displayed to the pharmacists as it would for each modality in the pharmacy setting. For the paper-based workflow, the pharmacists were provided a pre-completed Oregon SSRAQ with standardized patient information and the corresponding algorithm documents.[22] For the EHR encounters, the pharmacists were provided access to the EHR with standardized patient information from the digital self-screening questionnaire reformatted into an encounter note. In scenarios where USMEC contraceptive eligibility is determined by a sub-condition, the dynamic digital self-screening questionnaire automatically incorporates relevant follow-up questions to gather all necessary inputs. The static Oregon SSRAQ does not ask all sub-conditions, requiring follow-up questions for proper eligibility determination in certain scenarios. The moderator acted as the simulated patient in each encounter using a pre-established script, recorded the completion time and contraceptive outputs, and administered surveys for each encounter. The study team was not present for the encounters and was blinded to the pharmacist's numbered identities. The moderator performed the standardized patient encounters via Zoom teleconferencing software

(Zoom Video Communications, San Jose, CA). Before the encounters, the moderator provided each study participant with a study orientation, survey methodology instructions, a roughly 5-minute demonstration of the contraceptive-specific EHR, and Oregon BOP forms instruction. After each encounter, the study subjects completed a follow-up assessment of their experience, which included a variety of measures. Table 1 provides an overview of outcome measures utilized, which are matched to known barriers to PPCSs adoption. After the final encounter, participants completed an additional survey designed by the study team. The study was approved by the Western Institutional Review Board-Copernicus Group Institutional Review Board (IRB00000533).

Analysis

Encounter completion time

We assessed the completion time of each standardized encounter using a digital stopwatch. For the paper-based encounters, the Oregon SSRAQ and accompanying documents were provided to the pharmacists as hard copies and mailed in advance. Pharmacists were instructed not to open the envelope until prompted by the moderator during the encounter session. The moderator visualized the pharmacists on camera and began timing the encounter when the pharmacist removed the documents from the envelope. For the EHR encounters, the pharmacists were instructed to use the "share screen" function on the teleconferencing software, allowing the moderator to monitor their actions. The pharmacists gained EHR access immediately prior to the encounter. The moderator began timing the encounter when the pharmacist entered the patient's chart. The moderator stopped the encounters for both workflows after pharmacists finished the JCCP PPCP process, selected a specific contraceptive, and signed the chart either on paper or electronically.

Contraceptive method selection

Success criteria for contraceptive selection in the study were predetermined for each clinical scenario. For Patient 1, success criteria were defined as compliance with the Oregon BOP Standardized Assessment and Care Treatment Pathway, which was created as an adaptation of the USMEC guideline medical condition category matrix. The Patient 2 success criteria were defined as avoidance of prescribing a combined hormonal contraceptive (CHC) containing a progestin API that the patient previously poorly tolerated. Figure 1 provides standardized patient profiles and success criteria definitions.

Table 1. Relationship of selected study outcome measures and cited barriers to adoption and implementation success factors.

Study outcome measure	Barriers to adoption
Encounter completion time	Lack of available pharmacist time
Contraceptive output success criteria	Liability concerns, educational needs
National Aeronautics and Space Administration Task Load Index (NASA-TLX)	Workload
Health Information Technology Usability Evaluation Scale (Health-ITUES)	Usability
PAS survey	Perception, Attitude, Satisfaction

NASA-TLX

The NASA-TLX, originally developed for workload assessment in flight simulations, is a validated tool widely used in medical and pharmacy settings to measure perceived workload.[26–30] The NASA-TLX measures workload assessments based on ratings of 6 subscales: Mental Demands, Physical Demands, Temporal Demands, Own Performance, Effort, and Frustration. The data from the survey can be used to evaluate the subscales and pooled into an overall workload composite score that can be weighted by the importance of each subscale to create a weight-adjusted average overall workload score.[28,31,32] Prior to the study, the moderator educated the pharmacists regarding the proper use of the NASA-TLX paper forms. After each simulated encounter, the pharmacists completed a NASA-TLX survey.

Health-ITUES

The Health-ITUES is a 20-item survey on a 5-point Likert scale from strongly disagree to strongly agree with a 4-factor structure that includes quality of work life, perceived usefulness, perceived ease of use, and user control. The survey was developed as a usability survey instrument derived from the Health Information Technology Usability Evaluation Model (Health-ITUEM), an integrated model of multiple usability theories based on the concepts from the International Organization for Standardization (ISO) standard 9241-11 and the Technology Acceptance Model (TAM).[33–35] The survey has shown construct and predictive validity through confirmatory factor analysis, exploratory factor analysis, and structural equation modeling by the tool's creators and has been externally validated in multiple use cases.[34,36,37] Prior to the study, the pharmacists were instructed on the proper use of the paper version of the Health-ITUES. After each simulated encounter, the pharmacists completed a Health-ITUES survey.

Perceptions, attitudes, and satisfaction survey

To further elicit the pharmacists' attitudes and preferences, the investigators created a 17-item questionnaire that included dichotomous answer options, 5-point Likert scale ratings and three open-ended free-text prompts: (1) "Which barriers to the adoption of pharmacist-prescribed contraceptives does the [EHR] platform potentially solve?" (2) "Which barriers to the adoption of pharmacist-prescribed contraceptives does the [EHR] platform not solve?" (3) "Please provide any feedback you have on the [EHR] platform, including modifications or features that you would like to see." See Table 3 for the dichotomous and Likert scale question prompts. The PAS survey was administered after the surveys for the second encounter were completed. We conducted a thematic analysis of the open-text responses. Themes with more than 2 responses were included as final themes.

Statistical methods

We conducted descriptive statistics to assess pharmacist participant characteristics. We compared completion time and survey Likert scales using Koch's adaptation of the Wilcoxon-Mann-Whitney rank sum test, assessed compliance using McNemar's test for binary paired data and Fisher's exact test for within-patient comparisons.[38] All tests were pre-planned and are not adjusted for multiple comparisons.

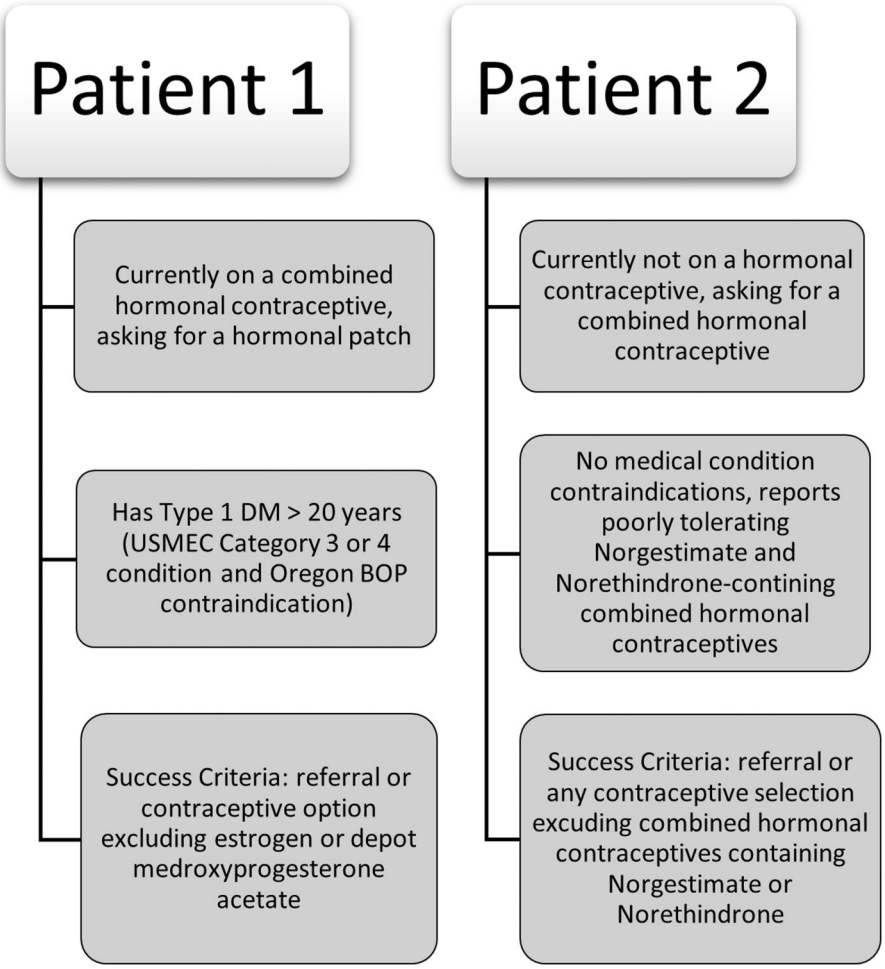

Figure 1. Standardized patient profiles and defined success criteria.

Results

Demographics

Twenty-three pharmacists were recruited, and 20 pharmacists completed all aspects of the study and were included in the final analyses. Three enrolled pharmacists were excluded from analysis. One failed to schedule the encounters and the other 2 received incorrect patient profile information on the paper forms and EHR. See Table 2 for an overview of the pharmacist cohort characteristics.

The study groups reflect generally comparable representation by gender, race, ethnicity, pharmacy setting, and experience in prescribing contraceptives and working with EHR. The odd-numbered group's age distribution (median 36, IQR 30.3-40.8) is somewhat older and more variable than that of the even-numbered group (median 31.5, IQR 28.5-32.8). Participants in the odd group also have more experience working as a pharmacist (median 8.5 years, IQR 5.3-13.3) as compared to the even group (median 3.5 years, IQR 2.3-6.5).

Encounter completion time

Median times to completion were 13:51 (13 minutes and 51 seconds) for the Oregon SSRAQ workflow and 13:29 for the EHR-based workflow. A rank sum test of the encounter completion time for the two conditions was not statistically significant ($P = .280$), however, the interquartile range for the Oregon SSRAQ was wider (10:52, 20:14) than the EHR-based workflow (9:42, 16:36). Completion time for the two conditions is illustrated in Figure 2.

Boxes are drawn to depict the 25th, 50th, and 75th percentiles. Whiskers indicate the most extreme value within 1.5 interquartile range of the 25th or 75th percentile. Any more extreme values are illustrated using individual points.

Contraceptive selection

Eight of the 20 pharmacists (40%) were compliant with the success criteria in contraceptive selection under both conditions, 1 (5%) was non-compliant under both, and the other 11 (55%) were compliant under the EHR-based workflow but not under the Oregon SSRAQ workflow. There were no pharmacists ($n = 0$) who were successful using the Oregon SSRAQ who failed success criteria in the EHR. This degree of discordance (55% vs 0%) is statistically significant ($P = .003$). Among pharmacists completing the Patient 1 encounter using the Oregon SSRAQ workflow, 80% prescribed a contraceptive that would be contraindicated by the USMEC guidelines. Comparatively, none of the pharmacists who completed the Patient 1 encounter using the EHR system prescribed a contraindicated contraceptive ($P < .001$). Among pharmacists completing the Patient 2 encounter using the Oregon SSRAQ workflow, 60% avoided prescribing a CHC containing Norgestimate or Norethindrone, which the patient had reported previously tolerating poorly. Comparatively, 90% of pharmacists completing

Table 2. Cohort characteristics.

Characteristic	Overall, $N = 20$	Odd group, $N = 10$	Even group, $N = 10$
Gender			
Female	11 (55%)	6 (60%)	5 (50%)
Male	9 (45%)	4 (40%)	5 (50%)
Race			
Asian	5 (25%)	2 (20%)	3 (30%)
Black	2 (10%)	2 (20%)	0 (0%)
More than one race	3 (15%)	2 (20%)	1 (10%)
White	10 (50%)	4 (40%)	6 (60%)
Ethnicity			
Hispanic or Latino	5 (25%)	2 (20%)	3 (30%)
Not Hispanic or Latino	15 (75%)	8 (80%)	7 (70%)
Age in Years: median (IQR)	32.0 (30.0, 38.5)	36.0 (30.3, 40.8)	31.5 (28.5, 32.8)
Predominant Pharmacy Setting			
Health-Systems Based Pharmacy	3 (15%)	1 (10%)	2 (20%)
Independent Pharmacy	11 (55%)	5 (50%)	6 (60%)
Large Chain Pharmacy	6 (30%)	4 (40%)	2 (20%)
Years as a Pharmacist: median (IQR)	5.5 (3.0, 9.5)	8.5 (5.3, 13.3)	3.5 (2.3, 6.5)
Prior Experience Prescribing Contraceptives			
No	18 (90%)	8 (80%)	10 (100%)
Yes	2 (10%)	2 (20%)	0 (0%)
Experience with EHR as a Provider			
No	8 (40%)	3 (30%)	5 (50%)
Yes	12 (60%)	7 (70%)	5 (50%)

the Patient 2 encounter using the EHR system avoided prescribing these options ($P = .303$).

NASA-TLX

EHR-based workflow raw score medians are generally lower than those associated with Oregon SSRAQ (except for the Frustration domain). Only the scores for the Mental Demand domain strictly demonstrate a statistically significant difference between conditions ($P = .003$), although the overall weighted scores exhibit marginal significance ($P = .075$). Raw scores for Physical Demand, Temporal Demand, Performance, Effort, and Frustration demonstrated no statistically significant differences between the treatment conditions ($P = .246$, $P = .211$, $P = .197$, $P = .138$, $P = .139$, respectively). Figure 3 displays the raw domain and overall weighted scores.

Boxes are drawn to depict the 25th, 50th, and 75th percentiles. Whiskers indicate the most extreme value within 1.5 interquartile range of the 25th or 75th percentile. Any more extreme values are illustrated using individual points.

Health-ITUES

EHR-based workflow score medians are generally higher than those under Oregon SSRAQ workflow (except for the Perceived Ease of Use domain, which was the same for both conditions). The Perceived Usefulness domain scores demonstrated a statistically significant difference between conditions ($P = .029$), while those for Impact and the overall scores exhibit marginal significance ($P = .067$ and $P = .075$, respectively). Figure 4 shows the response rates for each point in the 5-point Likert scale and the median score by Health-ITUES domain for each condition.

Perceptions, attitudes, and satisfaction survey

The responses from the dichotomous and Likert scale questions in the PAS survey are found in Table 3. A thematic assessment of the responses to the open-ended questions is found in Table 4. Broadly, pharmacists appreciated the increased confidence and efficiency of the EHR platform, but reported frustration that the system did not provide an explanation of why a particular method was contraindicated.

Discussion

The need for increased access to contraceptives in the US is well established and the importance has only increased following the 2019 Title X "gag rule," the US Supreme Court's Dobbs v. Jackson Women's Health Organization ruling, and the subsequent restrictive reproductive health laws implemented in many states. PPCS can increase access by reducing geographic, transportation, and financial barriers and increasing the availability of providers. Patients and pharmacists overwhelmingly support PPCSs, but the level of adoption has remained low due to several challenges, limiting the societal impact of this strategy.

One of the consistent barriers to adopting PPCSs cited by pharmacists is the lack of adequate time to add additional tasks to existing daily workflows.[13,15,16,39,40] Frost et al performed an observer timed study on standardized contraceptive patients in 13 pharmacies and found that the average time from arrival to the pharmacy to the generation of a written prescription was 17 minutes and 54 seconds.[41] Although there is currently no data in the literature to determine the time reduction threshold necessary to increase the adoption of PPCSs, given competing priorities and high workloads,[42] decreasing the time pharmacists spend providing contraceptive services is likely essential for widespread implementation success. Compared to the Oregon SSRAQ workflow, the EHR workflow showed a non-statistically significant decrease in encounter length. There was a smaller interquartile range distribution on the EHR workflow compared to the Oregon SSRAQ, demonstrating a more reliable process. The pharmacists in the study perceived these benefits, with 90% stating

Table 3. PAS survey dichotomous and Likert scale question responses.

Statement	*N* (%)
Questions about Pharmacy Contraceptive Prescribing	
Access to contraceptives is a problem in the United States	
Yes	20 (100%)
No	0 (0%)
Pharmacy-prescribed contraceptive services could greatly increase access to contraceptives in the US	
Yes	20 (100%)
No	0 (0%)
Pharmacists should be able to prescribe contraceptives	
Yes	19 (95%)
No	1 (5%)
Pharmacists who have taken the Comprehensive Contraceptive Education and Certification Course have the knowledge and skills necessary to safely prescribe contraceptives	
Yes	19 (95%)
No	1 (5%)
I would personally like to incorporate pharmacist-prescribed contraceptive services into my daily practice	
Yes	18 (90%)
No	2 (10%)
My career satisfaction as a clinical pharmacists would increase if I were providing pharmacist-prescribed contraceptive services	
Yes	20 (100%)
No	0 (0%)
Questions about the pharmacy contraceptive EHR	
Which of the two workflows did you prefer to use for the simulated patient encounters?	
Electronic Health Record	15 (75%)
Oregon SSRAQ	5 (25%)
The EHR platform increases my confidence in prescribing contraceptives	
True	16 (80%)
False	4 (20%)
The EHR platform makes pharmacist-prescribed contraceptive services more efficient	
True	18 (90%)
False	2 (10%)
The EHR platform makes pharmacist-prescribed contraceptive services safer	
True	20 (100%)
False	0 (0%)
The EHR platform would make incorporating pharmacist-prescribed contraceptive services into my daily clinical workflow more feasible	
True	19 (95%)
False	1 (5%)
The EHR platform was easy to learn with minimal training	
True	17 (85%)
False	3 (15%)
Likert Scale Scores	**Median**
How challenging was it to learn how to use the EHR platform to provide contraceptive services? [1 = Very Easy; 5= Very Difficult]	1
How would you rate the EHR platform overall as a technological solution for pharmacist-prescribed contraceptive services? [1= Very Poor; 5= Very Good]	5

that the EHR solution made prescribing contraceptives more efficient, and 95% stating that the EHR platform made incorporating PPCSs into their daily workflows more feasible. The thematic assessment of the open-ended questions in the PAS survey added additional qualitative support consistent with these findings.

In the 2019 National Pharmacist Workflow Survey (NPWS), 71% of pharmacists reported that their workload was "increased" or "greatly increased" compared to the previous year.[42] Higher workload is associated with increased risk of pharmacist dispensing errors, lower pharmacist job satisfaction, and higher burnout rates.[43–45] Given the current environment, minimizing the effect of PPCSs on the overall pharmacist workload is an important implementation factor. The EHR-based workflow demonstrated decreased scores on 4 of the 6 NASA-TLX domains, although only the decrease in Mental Demand was statistically significant. The overall weighted NASA-TLX scores also trended lower for the EHR workflow, but the difference was not statistically significant. A 2006 meta-analysis established interquartile ranges of overall raw and weighted mean NASA-TLX scores based on task category to allow for external comparisons. The "Medical" category in the meta-analysis demonstrated a range of 9.0-77.35 with mean interquartile range cutoffs for 25%, 50%, and 75% of 39.35, 50.60, and 61.45, respectively.[46] The EHR overall weighted workflow median score of 38.16 ranks under the 25th percentile cutoff for medical tasks compared with 57 for the Oregon SSRAQ workflow, which ranks in the 50th-75th percentile. This external comparison demonstrates the potential impact of the EHR-based workflow to minimize the workload contribution of PPCSs and increase the likelihood of acceptance and implementation success.

Usability factors remain among the most significant barriers to user acceptance and implementation of health IT systems, and when not considered, can introduce unintended consequences such as increased medical errors.[47–49] The TAM is one of the most accepted and validated theoretical frameworks to predict intentions to use a particular software system and predicts that user acceptance of any technology is predicated on two main factors: perceived usefulness and perceived ease of use.[50] Of the 2 main factors, research has demonstrated that perceived usefulness is the largest contributing factor to use and acceptance of technology.[51] The Health-ITUES is an integrated model of theories based on the concepts of usability from the TAM and the ISO standard 9241-11 and was chosen by the authors of this study due to its external validity and the adaptability of the prompts, allowing the comparison of the two conditions.[33–35] The EHR scored higher on usability for the overall score and 3 of the 4 domains with a statistically significant increase in the perceived usefulness score, demonstrating an increased likelihood of successful adoption and implementation of PPCSs.

Despite many studies demonstrating that pharmacists can safely prescribe contraceptives,[52] opponents of PPCSs continue to voice patient safety concerns.[53,54] Pharmacists additionally cite concerns regarding increased liability as a barrier to implementing pharmacy contraceptive services.[19,39,40] The USMEC guidelines are designed to decrease the incidence of severe adverse patient events and are the basis for all state-

specific pharmacist contraceptive prescribing guidelines. The EHR-based workflow demonstrated a statistically significant improvement in USMEC guideline compliance for the Patient 1 encounter with 100% compliance compared to 20% on the Oregon SSRAQ workflow. The EHR dynamic self-screening digital questionnaire prompts patients to answer additional questions as needed, identifying sub-

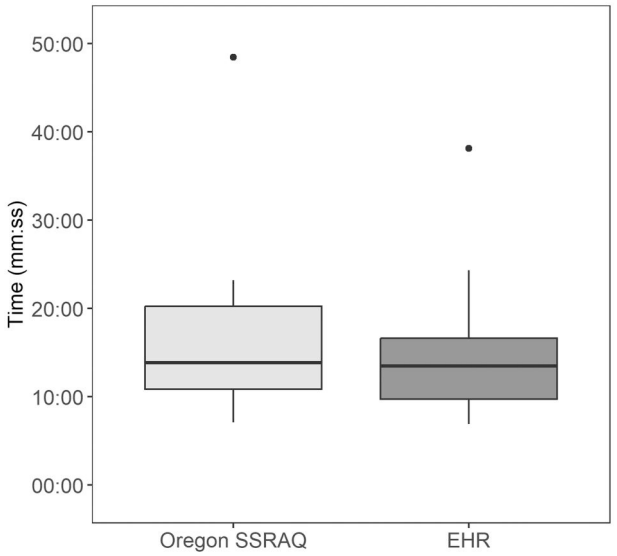

Figure 2. Encounter completion time by workflow modality.

conditions affecting USMEC guideline contraceptive eligibility. In Patient 1, diabetes duration exceeding 20 years made CHCs contraindicated. This information was readily available for pharmacists using the EHR workflow, unlike the Oregon SSRAQ workflow where additional questioning during the encounter was necessary. The authors hypothesize that the EHR-based workflow's advantage in USMEC compliance stems from its provision of more comprehensive information and contraceptive selection hard stop CDS. Every pharmacist in the cohort perceived that the EHR platform made prescribing contraceptives safer, and the thematic assessment of the open-response PAS survey questions further demonstrated that the pharmacists valued the contraceptive selection CDS. We anticipate that commercial implementation of an EHR platform with contraceptive CDS, such as the one utilized in this study, would address lawmaker patient safety and pharmacist liability concerns which could increase the adoption of these services.

One of the main elements of quality contraceptive care is person-centeredness, or the degree to which the patient's values and preferences are accounted for in contraceptive counseling. Person-centered counseling is associated with improved patient satisfaction and continued contraceptive use.[55,56] Additionally, a recent study assessing pharmacist self-perception of readiness to prescribe hormonal contraceptives revealed that 72% of respondents wanted more training on patient-specific contraceptive selection.[57] Incorporating patient feedback regarding previous hormonal contraceptive experiences is challenging for providers because of the

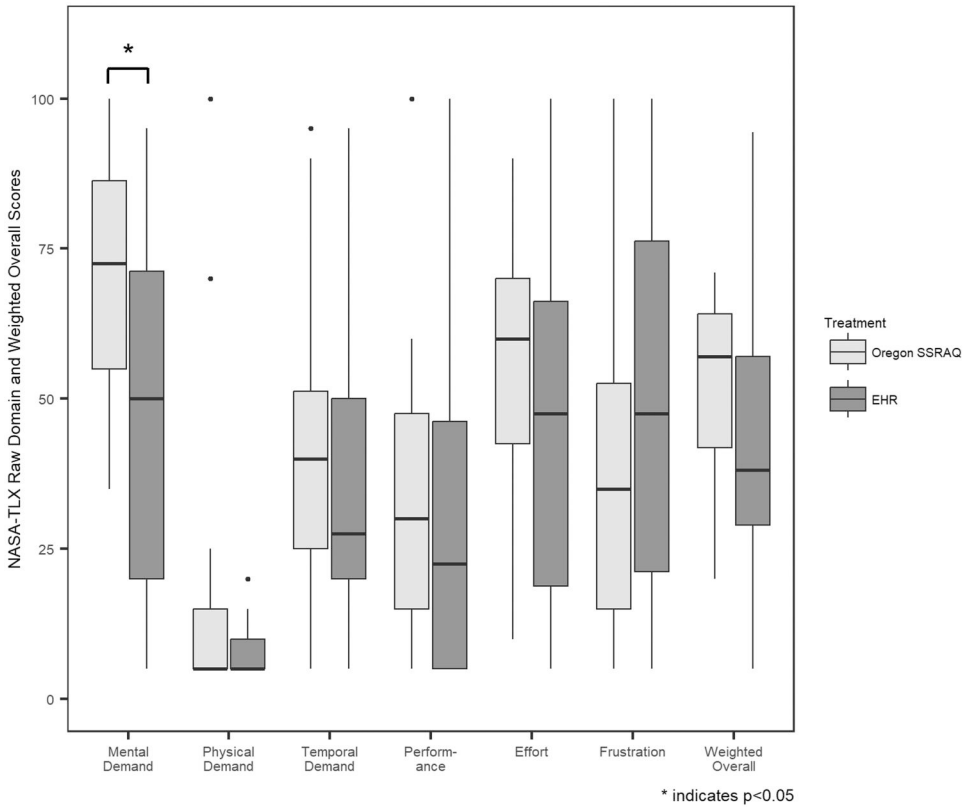

Figure 3. NASA-TLX raw domain and weighted overall scores by workflow modality.

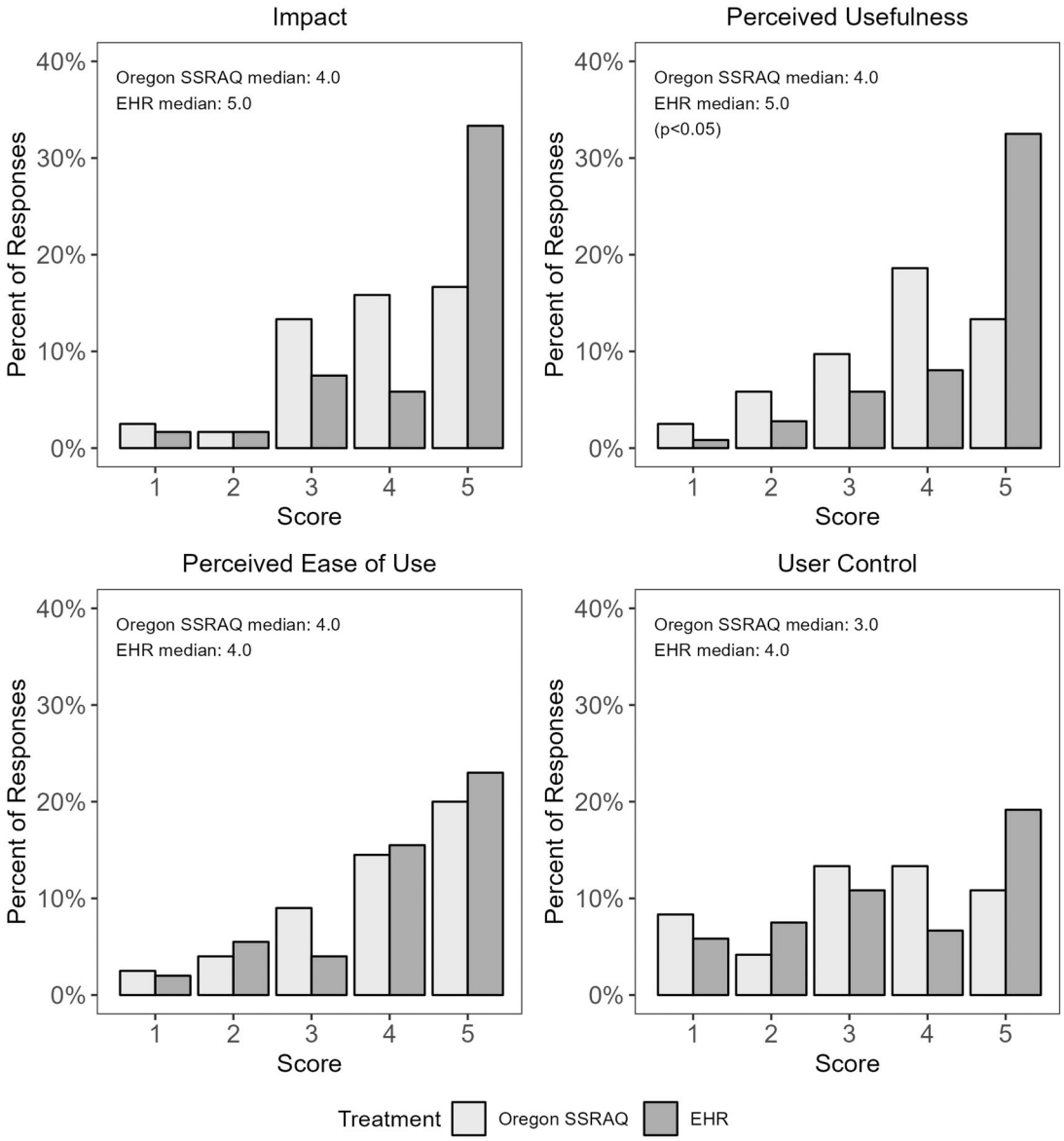

Figure 4. Health-ITUES percent of response by Likert score value and median by domain for workflow modality.

numerous and evolving contraceptive options available on the market, which share relatively few APIs. Avoiding APIs that a patient has previously poorly tolerated should be considered an important component of a patient-centered approach to care because side effects are the leading cause of combined oral contraceptive discontinuation.[58–61] Pharmacists evaluating Patient 2 on the EHR prescribed a CHC with an API that had been previously poorly tolerated on 10% of encounters vs 40% on the Oregon SSRAQ. Although this difference was not statistically significant, it demonstrates an important trend toward patient-centered medication selection. The thematic assessment of the PAS survey's open-response questions demonstrated that many pharmacists perceived the importance of the patient-centered approach to contraceptive selection. We anticipate that CDS guidance for patient-specific contraceptive selection could increase pharmacists' self-perception of readiness to prescribe hormonal contraceptives, potentially increasing adoption rates.

The results of the various outcome measures in this study favoring the EHR-based workflow are impactful, especially given that 40% of the pharmacists in the cohort reported never having utilized an EHR for patient-care activities before the study. Additionally, the pharmacists were only given about 5-minutes of EHR user training prior to the study. The Oregon SSRAQ-based workflow was more familiar to the participants because, in addition to a comparable 5-minute primer, the Oregon BOP-approved contraceptive continuing education course completed by all participants prior to the study included training regarding the proper use of the paper-based workflow used in the study. With more experience utilizing EHRs, there is a reasonable expectation that the EHR-based workflow could demonstrate more pronounced benefits. An additional potential benefit, not addressed in this study, is the expected decrease in dispensing time created by the electronic prescribing capabilities of the EHR which reduces the need for data entry in the pharmacy

Table 4. Thematic analysis of open-ended text responses and representative quotes from the PAS survey[a].

The EHR improved workflow and efficiency
"[The EHR platform helped solve] time constraints; it can take time to fill out paperwork. [This] didn't require any paperwork!"
"[The EHR platform] also allows us to send electronic prescriptions. I did feel like it was very efficient as well, which is very important."
The EHR improves patient safety
"[The EHR platform helped solve] safety concerns, flagging for contraindications, and lists available options with/in the type/method."
"The EHR platform helps to eliminate second guessing of which forms [of contraception] to use."
The EHR provides a patient-centered approach to contraceptive counseling
"The EHR platform solves] correctly prescribing (or not) contraceptives based on the patient, not a one size fits all."
"The EHR platform solves] choosing specific contraceptives. Upon assessing patient info, an idea of a type of contraceptive is easily found. Picking amongst varying brands is to the contrary, which is what [the EHR] solves."
The EHR increases access to contraceptives
"[The EHR platform] helps patients access birth control easier than trying to find an appointment to see their OB/GYN."
"[The EHR platform solves] access"
The EHR improves the confidence of the pharmacist in prescribing
"Pharmacists would feel more confident having [the EHR platform] which would likely increase the number of pharmacists that would be willing to prescribe contraceptives."
"[The EHR platform solves] confidence of the prescriber."
The contraceptive decision support user interface of the EHR needs improvement
"I would like to see the "why" it did not allow for a certain method to be chosen (if I choose the wrong CHC or POP form—I would love a pop-up that says, "Patient not eligible for this form because___"
"I would like feedback on why one option is not allowed. I feel like this program is amazing, but not having an option I expected (because I overlooked something) threw me off and made me take more time to determine why it wasn't an option. It was great that it wasn't an option, so it helped me prescribe more effectively, however an error or explanation would have been best."

[a] To be included in thematic findings, each theme needed to have 2 or more corresponding responses.

management system compared to the paper-based workflow. The thematic assessment of the open-response questions indicates a need for CDS tool user interface enhancements to provide user feedback regarding contraindicated contraceptive options. These modifications could further increase the advantage of the EHR over the paper-based workflow, additional investigation is warranted.

As a preliminary feasibility study, the pharmacist cohort had a small sample size ($n = 20$). The demographics were younger, less experienced, less female-dominated, and more racially diverse compared to the 2019 US pharmacist workforce from the NPWS data.[42] These factors limit the external validity of our findings. There was evidence of some between-group differences in experience and age. However, any impact of these differences on study results is likely mitigated by the cross-over design. The patient population in our study was limited to two standardized patients with a 50% prevalence of a medical contraindication for CHCs. In the Contraceptive CHOICE Project only 6.93% participants desiring CHCs were defined as having a potential medical contraindication.[62] The patient safety benefit of the EHR-based workflow in our study is therefore not generalizable. Additionally, although simulations can serve as a proxy, they do not directly represent pharmacist contraceptive services for real patients in a pharmacy setting. Another limiting factor of our study design was that each pharmacist used each workflow for a single encounter and study metric outputs may change with additional experience utilizing the workflows. Our study established that a contraceptive-specific EHR with CDS tools is a feasible option to address the barriers limiting the adoption of PPCSs. However, further studies in the pharmacy setting with real patients, larger sample sizes, and more encounters per pharmacist are warranted.

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Author contributions

Devin J. Bustin, Mary E. Kucek, Lissette Logan, and Heather Smith were involved with the conceptualization and methodology of the study. Devin J. Bustin, Mary E. Kucek, and Lissette Logan were involved in the investigation. All authors were involved in the analysis, writing of the original draft, and writing, review, and editing of the manuscript.

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Conflicts of interest

The EHR utilized in the study is owned by OvaryIt, LLC. D. J.B., M.E.K., and L.L. are employed by OvaryIt, LLC. H.S. is on the OvaryIt, LLC Board of Advisors.

Data availability

The data underlying this article will be shared on reasonable request to the corresponding author.

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