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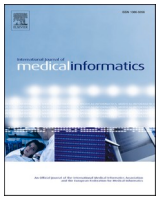

Physicians' perceptions of electronic prescribing of controlled medications in the West Bank, Palestine: A pre-implementation assessment

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ABSTRACT

Background: In Palestine, prescribing controlled medications is still done on paper. Despite valuable regulatory efforts, there is a high risk of undetected abuse and "doctor shopping". These problems can be addressed with electronic prescribing of controlled medicines (EPCM). User adoption is essential to the successful implementation of any technology. Therefore, it is crucial to determine the perception of end users at an early stage. This topic has never been addressed in Palestine. Our study aims to investigate the perception of Palestinian physicians towards the introduction of EPCM.

Methods: This cross-sectional study was conducted among Palestinian physicians in the West Bank who are familiar with controlled medications prescribing. Data were collected using a self-administered questionnaire based on the Unified Theory of User Acceptance and Use of Technology (UTAUT) from a convenience sample of 300 physicians. Data were analyzed using SPSS version 26. Bivariate analysis and binary and multivariate logistic regression were performed to identify factors associated with physicians' perceptions of ECPM.

Results: Most physicians expressed their willingness to use EPCM, with an acceptance rate of 85%. This perception was significantly affected by performance expectancy, effort expectancy and trust. None was moderated by age, gender, or experience with electronic prescribing. Age and specialization level were independent factors significantly influencing the intention to use EPCM. The level of current workflow challenges did not correlate with the intent to use EPCM.

Conclusion: Palestinian physicians will accept EPCM. Based on the results of this study, it is recommended that the following be considered: ensuring maximum efficiency of the system, selecting user-friendly interfaces and high-security measures to prevent system breaches.

1. Introduction

Electronic prescribing (e-prescribing) is a direct computer-to-computer communication for ordering, revising, reviewing, and transmitting prescriptions [1]. E-prescribing has the potential to enhance the quality, safety and efficiency of health care services [2–7]. It can reduce medication errors by eliminating the problems caused by the illegibility of handwritten prescriptions [8]. E-prescribing can also monitor compliance and suspected overuse or abuse as it provides a single view of prescriptions for multiple providers [9]. It results in fewer duplicate prescriptions and fewer calls to pharmacies with corresponding time and cost savings [9 10]. Also, e-prescribing, when supported by practice guidelines, has been shown to improve adherence to treatment guidelines and increase medical staff confidence in decision-making [7,11].

The above benefits make electronic prescribing of controlled medications (EPCM) promising. To date, prescribing these medications in most regions is done on paper, which carries the risk of abuse. For example, prescription fraud and counterfeiting contribute to a significant proportion of drugs diverted for abuse in the United States [9]. The phenomenon of doctor shopping is also a severe problem [12]. These problems are critical considering that worldwide use, abuse, and deaths from overdose of controlled medications are increasing [13–15]. Despite the hope that EPCM can curb the misuse of controlled medications, the adoption of EPCM worldwide is still limited. Nevertheless, where it has been successfully implemented, it has proven helpful in improving the

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prescribing of controlled medications [16,17–19].

User, technology, or organizational factors that could affect the success of the deployment must be investigated before implementation [20]. This is critical because the vast majority of health information technologies (HIT) fail in some way, despite the significant investment and widespread availability of these technologies [6,20]. Barriers frequently cited include cost, lack of adequate training and clinical support, workflow changes, connectivity issues, hardware and software problems, interoperability issues, and the frequent need for guideline updates [21,22]. Physician resistance has also been identified as a significant barrier [23–25,26]. Therefore, it is essential to understand physicians' perceptions to reduce physician resistance [11,20,21,24,25,27]. Accordingly, researchers have become more interested in studying user perceptions, as these insights can help predict intent to use and actual use of a proposed technology [25].

In Palestine, prescribing controlled medications is still done on paper [28,29]. However, it is believed that the current system cannot strictly regulate prescribing because, in addition to the reasons mentioned above, it lacks a central monitoring point for multiple governorates. This increases the risk of "doctor shopping," with the subsequent increase in controlled medications misuse.

Given the weaknesses of paper prescribing and the benefits of electronic prescribing, electronic prescription of controlled medications (EPCM) is a reasonable transition. In this study, we aim to explore how Palestinian physicians perceive the introduction of a stand-alone EPCM and how this perception affects their intention to use it.

2. Materials and methods

2.1. Study design and setting

This quantitative cross-sectional study was conducted using a self-administered questionnaire in the West Bank of Palestine in 2022. Data was collected from physicians at their workplaces (clinics, hospitals, medical centers, etc.). All regions of the West Bank were covered: the north (Nablus, Tulkarem, Qalqilya, Jenin, Tobas, Salfit), the center (Ramallah, Jericho, suburbs of Jerusalem) and the south (Hebron and Bethlehem).

2.2. Population and sample size

The target population is Palestinian physicians living in the West Bank who practice controlled medication prescribing, or have practiced controlled medication prescribing in the past, identified as those registered by the Palestinian ministry of health as current or previous holders of the unified controlled medication prescription pad. The main reason for including previous users is that they are familiar with the prescription pad, which was installed in 2016 and is currently in use. So, their experience is valuable and there is no reason to exclude them, especially since the current system could be the reason they stopped.

Those who matched the previous definition were eligible for inclusion and no further exclusion criteria were applied. The prescription pad is not used in governmental healthcare facilities because they have their own internal prescribing regulations, so they were not included in this study. According to the ministry of health, 1260 physicians met the above criteria in 2021. Using raosoft with a margin of error of 5%, a confidence interval of 95%, and a 50% response distribution, the required sample size was 295 physicians. However, since no names were provided, randomization was not feasible. The lack of names, however, made randomization impossible. Therefore, 300 practitioners were targeted regardless of their region, speciality, workplace, or age.

2.3. Research model and hypotheses

The conceptual framework of this research is derived from the Unified theory of acceptance and use of technology (UTAUTI). Trust and workflow challenges were introduced as new components to the original model, while social influence and facilitating conditions were removed. Knowing that security issues are a well-established concern for many technology users, it is crucial to consider the trust factor when assessing physicians' perception toward adopting EPCM, especially since controlled medications pose a high risk for addiction and misuse [30]. For the workflow challenges, we presumptively infer that physicians will be more open to EPCM if they are more unsatisfied with the current prescribing methods. Regarding social influence: for such an effect to be socially derived, there must be an actual prevalence and users of a specific intervention in a person's network (social referents) [31]. Since EPCM has never been used in Palestine, this construct was omitted. It is assumed that the effect of facilitating conditions on intention to use is mediated by effort and performance expectancy. Therefore, when these two constructs are considered, the prediction of choice to use by facilitating conditions does not become significant. In addition, reducing conditions were found to influence actual use but not intended use, which was not examined in this study [32]. For this reason, this construct was omitted from this study. Ultimately, the dependent variable was intention to use EPCM, while independent variables included: WFC, PE, EE and trust. Moderators included: age, gender, and experience with e-prescribing (Fig. 1).

H1: Workflow challenges (WFC) influence behavioral intention to use EPCM.

H2: Performance expectancy (PE) influence behavioral intention to use EPCM.

H3: Effort expectancy (EE) influence behavioral intention to use EPCM.

H4: Trust influences behavioral intention to use EPCM.

2.4. Survey instrument

The survey instrument was derived from previous studies [9,33,34], and Palestinian specialties observations (Appendix A). It consists of the following parts; Part 1: Demographics and background information; Part 2: WFC of controlled medications, computer use–personal experience and experience with E-prescribing; Part 3: It is made up of 3 constructs; PE, EE and trust; part 4: intention to use EPCM. Each item in part 3 and 4 is measured using a 5-point Likert scale ranging from "strongly disagree (1)" to "strongly agree (5)". The complete questionnaire is available in Appendix.

2.5. Questionnaire validation and reliability

Seven specialists validated the questionnaire's final version, including two professors of health informatics, two professors of statistics, one professor of health information technology, and two academic pharmacists. The seven specialists reviewed the developed survey and suggested changes in the wording and structure of some items to improve understandability and readability. It also underwent a pilot test on ten physicians [35]. This number was considered sufficient as no major comments were provided. Principal Component Analysis (PCA) method was performed with varimax rotation to reduce the variables' number while keeping a maximum variance as a sufficient correlation was achieved among the original variables [3637]. More details can be found in the data analysis section below.

2.6. Data collection

Since a list of prescribers' names wasn't provided, data gatherers contacted doctors from other specialties at random offices to see if they had met the requirements before asking the targeted doctor to complete the questionnaire. Each participant received a brief introduction to e-prescribing before beginning the questionnaire. Data collection was conducted between June and July 2022. Data collectors were two pharmacists that received the same training and instructions.

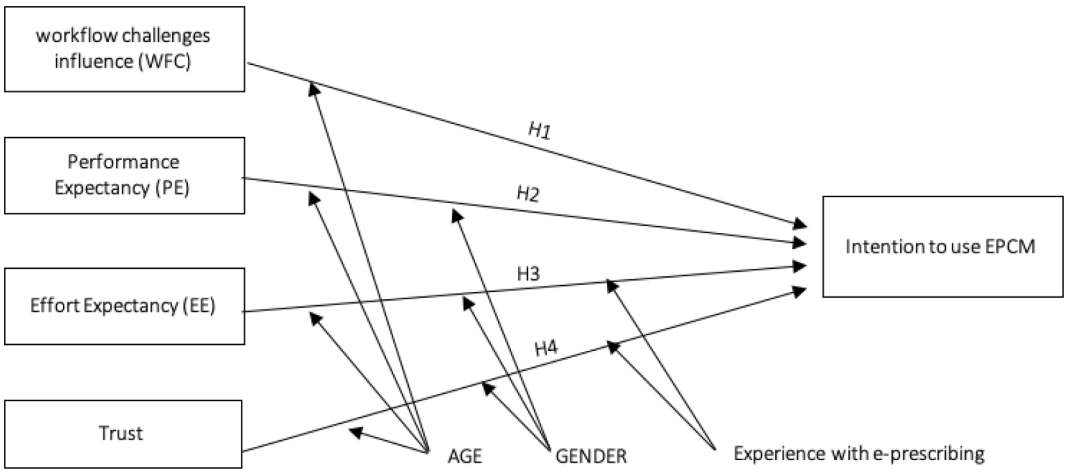

Fig. 1. Conceptual Framework.

2.7. Ethics

The American Arab University, research committee (2022/4/19), the Palestinian Ministry of Health, and the Palestinian Physicians' Syndicate granted the researcher permission to conduct this study. Each questionnaire came with a consent document that explained the study's objectives, the participants' freedom to decline to participate, and the strict secrecy with which the information would be treated.

2.8. Statistical analysis

Data were entered into Statistical Package for the Social Sciences (*IBM SPSS) version 26.0.0.0*, cleared, coded and categorized as study needed. PCA with varimax rotation was performed to extract factors using the loading criteria of 0.40 and above, and Eigenvalue was set to be 1 [38]. Twenty-four items were examined, and the subscale items related to e-prescribing difficulty (9 items) and e-prescribing expectancy (15 items) were analyzed separately. The validity of construct was measured using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's sample tests. Then, the reliability coefficient for each scale was calculated using 1) Cronbach's alpha for each subscale and 2) no increase of more than 0.1 for Cronbach's α when an item was deleted from the scale.

Descriptive statistics were performed to present data. Recoding for the dependent variable, intention to use EPCM, was reduced into two categories: disagree and agree. Neutral responses were coded as missing values as they neither confirmed the use of electronic prescription nor refused, they seem as if they do not want to answer. Bivariate analyses, was not conducted on this group and they were coded as missing values. The mean, median, skewness, minimum, and maximum values were obtained for each construct. The data for each construct were normally distributed. Pearson Correlation test was performed to assess the relationship between the five constructs after checking the absence of co-linearity between them. Univariate logistic regressions were performed to measure the association between continuous variables (age, UTAUT constructs) and intention to use EPCM. Pearson's Chi-square test was conducted to assess the association between the expected categorical moderators (gender, age, and previous experience in e-prescribing) and to use of EPCM. Then, a multivariate model using enter method was conducted between each construct and the expected significant moderators as the model gets built. The multivariate logistic regression models, adjusted for moderating variables, were performed to identify the interaction effects between the UTAUT construct and the intention to use EPCM.

3. Results

3.1. Construct validity

The PCA with varimax rotation manifested that the variable's KMO value was 0.662 for the WFC construct and 0.936 for the expectancy construct, indicating that the validity of each variable in the sample data is good. The significance level of Bartlett's test was < 0.001 for each.

A total of 24 items related to the UTAUT model loaded significantly on five factors where WFC construct loaded better as two subconstructs named as WFC annoying situations (WFC AS) and WFC concerns (WFC

Table 1
Rotated Factor Analysis of the UTAUT Model.

Subscale	# of items	Factor loading	Eigenvalue	%Variance Explained	Cronbach's α
WFC C	4	0.484–0.794	2.218	27.723	0.65
WFC 1		0.794			
WFC 2		0.785			
WFC 3		0.484			
WFC 8		0.621			
WFC AS	4	0.517–0.713	1.643	20.541	0.544
WFC 4		0.636			
WFC 5		0.517			
WFC 6		0.713			
WFC 7		0.683			
PE	5	0.553–0.766	1.262	8.411	0.869
PE 1		0.676			
PE 2		0.565			
PE 3		0.553			
PE 4		0.736			
PE 5		0.766			
EE	5	0.614–0.682	0.996	6.373	0.875
EE 1		0.614			
EE 2		0.688			
EE 3		0.688			
EE 4		0.680			
EE 5		0.682			
Trust	5	0.725–0.849	8.631	57.539	0.917
Trust 1		0.766			
Trust 2		0.849			
Trust 3		0.757			
Trust 4		0.725			
Trust 5		0.727			

WFC C: workflow challenges concerns, WFC AS workflow challenges annoying situations, PE: performance expectancy, EE: effort expectancy, T: Trust
Eigenvalue: a factor if > 1, % variance: the proportion of explained variance in the original data by each factor
Cronbach's a: Excellent: $a \geq 0.9$, good: $0.7 \leq a < 0.9$, acceptable: $0.6 \leq a < 0.7$, poor: $0.5 \leq a < 0.6$, unacceptable: $a < 0.5$)

C). Table 1 shows the range of factor loadings for the items retained for each element and the eigenvalues and variance explained for each aspect. Four of the five factors had eigenvalues above 1. In contrast, one factor had an eigenvalue close to 1, with a total explained variance of 48.264% for WFC factors combined, and 72.323% for PE, EE and trust, combined. Two items were cross-loaded across two factors (EE1, PE3) for the expectation factor, and one was cross-loaded across two factors (WFC3) for the WFC factor. These items were kept and loaded on the construct with the higher value as the difference between values was sufficient and their communalities value was more than 0.5. The internal consistency (Cronbach α) for the factors variates from excellent (Cronbach α = 0.92) for trust and poor (Cronbach α = 0.544) for WFC AS.

3.2. Sociodemographic Characteristics of Participants.

A total of 300 responses were collected. The majority (90.3%, n = 271) of responders were males. Responders' mean age was 40.89 years. Most responders were specialists (69.6%, n = 209), with the remainder being general practitioners and subspecialists (Table 2).

3.3. Overall perception of EPCM

The majority of responders had a positive perception toward adopting EPCM, intending to adopt rate of 85% (agree n = 93, strongly agree n = 162). Furthermore, the existing prescribing system has to be improved concurrently, according to 80% (n = 240) of respondents.

3.4. Technical readiness and experience with E-Prescribing

The majority of participants, 284 (94.7%) reported they are comfortable with computer use, 98.7% (n = 296) have a personal smart phone or computer and 283 (94.3%) have a stable internet connection most of the time. A total of 80% (n = 240) of participants are familiar with the concept of e-prescribing with 72% (n = 216) that had used e-prescribing before.

3.5. Workflow challenges

Out of all participants, 60.3% (n = 181) of them find it difficult to renew their prescriptions pad. Fifteen percent (n = 45) of participants reported that their prescription pad, or part, was stolen. (Fig. 2).

3.6. PE, EE and trust

The variation in PE, EE, and trust of EPCM is described in Table 3. Most responders (79.3%, n = 238) believe EPCM will help them write prescriptions that comply more with medical legislation and recommendations. Nearly three-fourths of the participants (73.3% (n = 220)) believe that EPCM will be easy to use, and 75.6% (n = 227) of participants believe that EPCM will reduce the risk of prescription manipulation.

Pearson Correlation test was performed to assess how close the linear relationship was between subscales. The UTAUT correlation coefficients ranged from a little positive correlation between WFC AS & EE (0.038), and a high positive correlation between PE&EE (0.702). No multicollinearity existed between the variables tested in this study.

In the univariate logistic regression, PE, EE and trust were significantly associated with the intention to use EPCM. Multivariate logistic regression showed that the three factors (PE, EE, and trust) did not impact each other. In addition, these three factors, PE, EE, and trust, have a positive association with the intention to use EPCM, the adjusted OR with 95% confidence interval (CI): 7.033 [2.637–18.757]; 7.021 [2.9–16.998], and 4.824 [2.343–9.929] respectively, and P-value < 0.001 for each, and they are good predictors of physicians' willingness to use EPCM.

Level of specialization was found to be significantly associated with using EPCM as general practitioners, and sub-specialist, were more willing to use EPCM when compared to specialties (p-value < 0.05). Meanwhile, no significant association was found between gender or experience in e-prescribing and intention to use EPCM (P > 0.05). Regarding age, it showed a positive association with intention to use EPCM (P = 0.032). Pearson correlation test was conducted to differentiate age impact on the UTAUT model constructs. The initial results revealed that age was significantly associated with the PE scale (p-value = 0.48).

Binary logistic regression adjusted for age and interaction effects was then performed. It revealed a significant association between age, PE and the intention to use EPCM (P-value = 0.019, P-value < 0.001) respectively. The absence of a significant association between age and PE interaction revealed that the age of respondents did not affect the relation between PE and the intention to use EPCM. Whilst it was not a moderator, it could be classified as an independent variable negatively

Table 2
Participants' Sociodemographic Characteristics.

Individual-level variable	n	Percent %	Mean ± SD
Age	300		40.89 ± 10.4
Less than 30	38	12.7	
30–39	117	39.0	
40–49	89	29.7	
More than or equal 50	56	18.7	
Gender			
Male	271	90.3	
Female	29	9.7	
Region			
North (Nablus, Salfit, Qalqelieh, Jenin, Tulkarem)	125	41.6	
Middle (Ramallah/ Bireh, Jerusalem, Jericho)	112	37.4	
South (Hebron, Beithlahim)	63	21	
Specialty			
General practitioner/ Family medicine doctor	79	26.4	
Internal medicine doctor	58	19.3	
Cardiologist	5	1.7	
Orthopedics	60	20	
General surgeon	25	8.3	
Emergency Room Doctor	8	2.7	
Neurologist	9	3	
Psychologist	2	0.7	
Dentist	13	4.3	
Gynecologist	12	4	
Oncologist	5	1.7	
Pediatrician	6	2	
ENT	7	2.3	
Others (Anesthesiologist, Dermatologist, Ophthalmologists, Urologist)	11	3.6	
Level of specialization			
Medical doctor	77	25.6	
Specialist	209	69.7	
Sub-specialist	14	4.7	
Experience in medicine (years)			12.25 ± 9.6
<5	64	21.3	
5–9	81	27.0	
10–14	63	21.0	
15–19	27	9	
More than or equal 20	65	21.7	
Workplace			
Private clinic	209	69.7	
Private hospital	76	25.3	
Oncology center	10	3.3	
Mental/ Psychiatric/ Rehabilitation clinic	5	1.6	
Number of prescriptions per month			
<5	151	50.3	
5–50	85	28.3	
50–100	16	5.3	
More than 100	5	1.7	
Stopped	43	14.3	

*n is the number of participants occurrence in the defined category, % is the percentage of cases in defined category, SD standard deviation

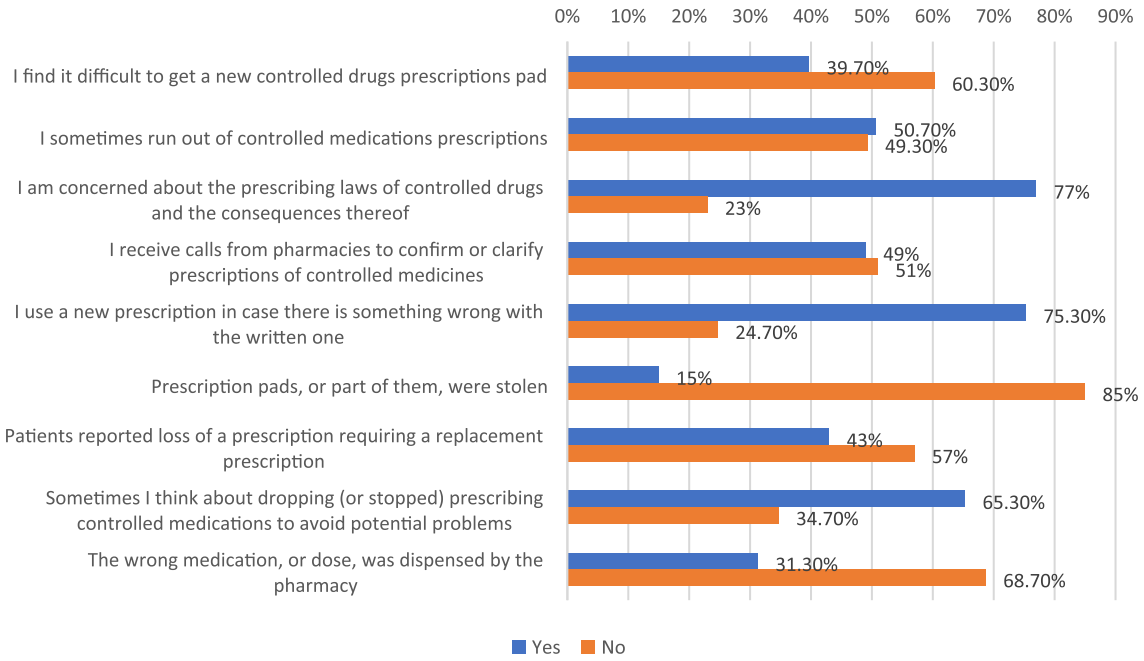

Fig. 2. Participants Answers to Questions Regarding workflow Challenges.

affecting the respondents' desires to go toward e-prescribing.

4. Discussion & Conclusion

This study showed that the vast majority of included providers had a positive attitude toward the adoption of EPCM, indicating that they would use it if given the opportunity. Users' intention to use EPCM was most influenced by PE, EE, and trust.

PE was found to have a significant correlation with the intention to use EPCM, as those who believe EPCM will be beneficial are more willing to use it. This result is consistent with other studies. [20,34,39,40]. Since users' lack of understanding of e-prescribing benefits could diminish end users' desire to use it, education about EPCM features and capabilities is expected to improve physicians' perception [21]. For example, those who do not believe that EPCM can reduce medication errors can be educated about the potentials of electronic prescribing with the integrated alerts, guides, clinical decision support systems (CDSS), and even denial of some transactions if they are legally or medically incorrect. In addition, EPCM will likely be able to prevent the phenomenon of "doctor shopping" by collecting all prescriptions for a particular patient from all physicians into one screen, based on which a physician can decide whether this is the right time to re-prescribe a particular drug. Thus, some physicians will likely view EMPC differently after sufficient training and education.

Like other studies, EE was significantly associated with physicians' perception of EPCM. [34,40]. This means that the more a physician believes EPCM will be easy to handle and practical to use, the more positive his perception of EPCM will be. This result can be used as a tool by stakeholders to alleviate the resistance of those who expect EPCM to be complicated. For example, they might consider simplifying the system's interfaces and making navigation easy. Poor design and technical concerns were once reported as the most common barrier to e-prescribing [20]. Therefore, it is better to involve practitioners in the designing process of the system to make sure it meets their expectations.

Regarding trust, in this study, this construct was found to be significantly associated with the intention to adopt EPCM. This means that those who believe EPCM will be more secure and trustworthy than paper prescribing are more willing to use it. This finding has been repeatedly noted in studies examining perceptions of the adoption of technologies that pose some threat to users' private information, money, or practices where legal consequences are a natural concern [34,41–43]. Security concerns were reported to be a significant barrier to e-prescribing, but surprisingly, this concern lessened post-implementation as reported in several studies that were addressed in Gagnon et al. (2014) review. If this result is to be best used in making physicians more willing to use the system, EPCM should be equipped with robust security and data breach prevention measures.

Regarding WFC, its effect on the intention to adopt EPCM was statistically non-significant. Considering that the internal consistency of its two sub-constructs ranged from acceptable to poor, more questions needed to be added to enhance that construct strength.

In alignment with previous work in the health information technology acceptance field, gender and experience did not mediate the effect of the primary constructs on the intention to use EPCM, nor has a direct impact on the intention to use EPCM [44]. However, age was found to have a statistically significant direct relationship with intent to use EPCM, where older physicians were less willing to use EPCM, which is consistent with previous work [45–47]; this could be due to technology anxiety "technostress" and resistance to change [48].

Finally, regarding technical readiness, it was found that most participants had the tools to operate EPCM once it was ready to be launched. The proposed technology requires that physicians have stable internet access, a smartphone or personal computer and comfort with computer use. This means that equipping physicians, which could have been a source of significant expenditure, is not a concern as this prerequisite is fulfilled for most of the sample.

In summary, Palestinian physicians are open to the recommended technology. The most important factors influencing their perception of EPCM are PE, EE, and trust. Therefore, these factors should be considered in developing the software, as they significantly increase users' willingness to use EPCM and reduce the risk of failure.

5. Strengths

This is the first study to address perceptions of electronic prescribing of controlled medications in Palestine and the Middle East and one of few studies addressing this issue worldwide. This study provides a good understanding of the critical factors that affect physicians' willingness to

Table 3
Distribution of PE, EE and Trust.

Item	% of participants, n = 300				
	SD	D	N	A	SA
PE					
Electronic prescription for controlled medications will help me do my work faster	3.7	4.7	14	37.7	40
Electronic prescribing will help me write prescriptions that are more compliant with medical legislation and recommendations	2.3	5.3	13	40	39.3
Electronic prescribing will reduce the spread of addiction and abuse of controlled drugs	2.7	5.3	14	31.3	46.7
Electronic prescribing of controlled medications will reduce medical errors	2.7	6	16.3	36	39
Electronic prescribing of controlled medications will Improve patient satisfaction	6.3	10.7	19.7	30.3	33
EE					
The use of electronic prescribing of controlled medications will be easy	2	7.7	17	37	36.3
The use of electronic prescribing of controlled medications will not affect my work routine	3.3	7.3	17.3	38.3	33.7
Renewing prescriptions using electronic prescribing for controlled medications will be easier	1.7	3.7	14.7	42.7	37.3
Editing prescriptions through electronic prescribing of controlled medications will be easier	0.7	5	12.3	45.3	36.7
Cancellation of prescriptions through electronic prescribing of controlled medications will be easier	0.7	5.3	14.3	42.3	37.3
Trust					
Electronic prescribing of controlled medications will reduce the opportunity to hack the system, impersonate a doctor, and dispense false prescriptions	3.7	6.7	14	34.3	41.3
Electronic prescribing of controlled medications will facilitate tracking of the breach if it occurs as it will be possible to invalidate the prescriptions easily unlike paper prescriptions	3	6	14	34	43
Electronic prescribing of controlled medications will be more protective of patient data	2	6	14	34.3	43.7
electronic prescription of controlled medications will accurately document all prescriptions dispensed	0.7	4	12	34.7	48.7
Electronic prescribing of controlled medications tracks medical errors more easily	3.3	3	11.3	40.3	42

SD: Strongly Disagree, D: Disagree, N: neutral, A: agree, SA: Strongly agree

use EPCM. This paves the way for smoother implementation of EPCM and reduces the risk of failure and the associated waste of resources.

6. Limitations

This research is based on a convenient sample, as randomization was not possible. Also, The Gaza Strip was not included due to several reasons. One of these reasons is the denied access to the strip due to the occupation.

Appendix A

The Sources of The Questionnaire's Items

The tool was validated and a reduction of variables was achieved using PCA as this is a new tool. The internal consistency was tested, but no Confirmatory factor analysis (CFA) was conducted to confirm the resulting factors.

7. Summary points

What we already know:

- E-prescribing is a promising HIT that has improved healthcare safety and quality.
- Controlled medication misuse is a global concern that is still on the rise, and moving toward the e-prescribing could help improve the situation.
- Physician resistance is a significant concern that should studied before the adoption of any HIT.

What this study added to our knowledge.

- Palestinian physicians' intention to use EPCM is significantly affected by PE, EE and trust.
- Physicians who believe EPCM will add value to their work are more willing to use it.
- Physicians who believe EPCM will be easy to navigate are more willing to use it.
- Physicians who believe EPCM will be hard to breach are also more willing to use it.

CRediT authorship contribution statement

Hiba Falana: Conception and design, data collection, analysis, drafting, revising, review and editing. **Shahenaz Najjar:** Conceptualization, methodology and design, validation of the study tool; writing – review and editing; and overall project leadership and supervision. **Yousef Mimi:** Study design, validation of the study tool; co-supervision; review and editing. **Ni'meh Al-Shami:** Data analysis and review and editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Statement on conflicts of interest

All authors declare no conflict of interest, and there are no competing financial interests to disclose. We attest that the submission is unique and is not currently being considered by another publisher. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

	workflow challenges (WFC)	Source
WFC1	أجد صعوبة في الحصول على دفتر وصفات مراقبة جديد	New/ specific to the Palestinian context
WFC2	I find it difficult to get a new controlled drugs prescriptions pad تنفذ وصفات الأدوية المراقبة المتوفرة لدي أحيانا	New/ specific to the Palestinian context
WFC3	I sometimes run out of controlled medications prescriptions اشعر بالقلق بشأن قوانين وصف الأدوية المراقبة وما يلي ها من تبعات	New/ added by researcher based on feedback form several physicians during validation
WFC4	I am concerned about the prescribing laws of controlled drugs and the consequences thereof أتلقى مكالمات من الصيدليات لتأكيد او توضيح وصفات الادوية المراقبة	[9 33]
WFC5	I receive calls from pharmacies to confirm or clarify prescriptions of controlled medicines استخدم وصفة جديدة في حال وجود خطأ ما في الوصفة	New/ added by researcher based on feedback form several physicians during validation
WFC6	I use a new prescription in case there is something wrong with the written one تعرضت لسرقة دفتر الوصفات المراقبة، أو جزء منه، من قبل	[9 33]
WFC7	Prescription pads, or part of them, were stolen تم كتابة وصفة طبية جديدة لفقدان المريض الوصفة المكتوبة سابقا	[9 33]
WFC8	Patients reported loss of a prescription requiring a replacement prescription أفكر احيانا في التخلي عن وصف الادوية المراقبة (أو توقفت عن وصفها) لتجنب المشاكل المحتملة	New/ added by researcher based on feedback form several physicians during validation
WFC9	Sometimes I think about dropping (or stopped) prescribing controlled medications to avoid potential problems تم صرف علاج خاطئ او جرعة خاطئة من قبل الصيدلية	[9 33]
	The wrong medication, or dose, was dispensed by the pharmacy **Technical readiness**	
B1	امتلك حاسوب شخصي أو هاتف ذكي	[33]
B2	I have a smart phone or personal computer استخدم الحاسوب أو الأجهزة الذكية بشكل مرضي	[33]
B3	I am comfortable with computer use Computer تتوفر شبكة انترنت مناسبة معظم الوقت	New/ added by researcher
	I have a stable internet connection most of the time **Experience**	
C1	عندي معرفة بالمفهوم العام للوصف الالكتروني للأدوية	[34]
C2	I am aware of the concept of electronic prescribing لدي تجربة في استخدام الوصف الالكتروني للأدوية في عملي الحالي او السابق	[34]
	I have experience using e-prescribing in my current or previous job **Performance expectancy**	
PE1	الوصف الالكتروني للأدوية المراقبة سيساعدني في القيام بأعمالي بشكل أسرع	[34]
PE2	Electronic prescription for controlled medications will help me do my work faster الوصف الالكتروني سيساعدني على كتابة وصفات أكثر التزاما بالتشريعات والتوصيات الطبية	[9]
PE3	Electronic prescribing will help me write prescriptions that are more compliant with medical legislation and recommendations الوصف الالكتروني سيحد من انتشار الإدمان وإساءة استخدام الادوية المراقبة	[9]
PE4	Electronic prescribing will reduce the spread of addiction and abuse of controlled drugs الوصف الالكتروني للأدوية المراقبة سيقلل من الأخطاء الطبية	[9]
PE5	Electronic prescribing of controlled drugs will reduce medical errors الوصف الالكتروني للأدوية المراقبة سيحسن من رضى المرضى	[9]
	Electronic Prescribing of Controlled Drugs Will Improve Patient Satisfaction **Effort expectancy**	
EE1	استخدام الوصف الالكتروني للأدوية المراقبة سيكون سهلا	[34 9]
EE2	The use of electronic prescribing of controlled medications will be easy استخدام الوصف الالكتروني للأدوية المراقبة لن يؤثر على روتين عملي	[33]
EE3	The use of electronic prescribing of controlled medications will not affect my work routine تجديد الوصفات باستخدام الوصف الالكتروني للأدوية المراقبة سيكون أسهل	[33]
EE4	Renewing prescriptions using electronic prescribing for controlled medications will be easier تعديل الوصفات من خلال الوصف الالكتروني للأدوية المراقبة سيكون أسهل	[33]
EE5	Editing prescriptions through electronic prescribing of controlled medications will be easier الغاء الوصفات من خلال الوصف الالكتروني للأدوية المراقبة سيكون أسهل	New/ added by researcher
	Cancellation of prescriptions through electronic prescribing of controlled medications will be easier **Trust**	
T1	الوصف الالكتروني للأدوية المراقبة سيحد من فرصة اختراق النظام وانتحال شخصية طبيب وصرف وصفات مزورة	[33]

(*continued on next page*)

(*continued*)

	workflow challenges (WFC)	Source
T2	Electronic prescribing of controlled medications will reduce the opportunity to hack the system, impersonate a doctor, and dispense false prescriptions الوصف الالكتروني للأدوية المراقبة سيمنع تتبع الاختراق اذا حدث حيث سيكون من الممكن ابطال الوصفات الورقية بسهولة عكس الوصفات	[9 33]
T3	Electronic prescribing of controlled medications will facilitate tracking of the breach if it occurs as it will be possible to invalidate the prescriptions easily unlike paper prescriptions الوصف الالكتروني للأدوية المراقبة سيكون أكثر حماية لبيانات المريض	[9 33]
T4	Electronic prescribing of controlled medications will be more protective of patient data الوصف الالكتروني للأدوية المراقبة سيقوم بالتوثيق الدقيق لكافة الوصفات المصروفة	New but with a concept similar to ([33] / fear that work would be controlled
T5	Electronic prescription of controlled medications will accurately document all prescriptions dispensed الوصف الالكتروني للأدوية المراقبة يتتبع الأخطاء الطبية بشكل أسرع Electronic prescribing of controlled medications tracks medical errors more easily	New but with a concept similar to [33] / fear that work would be controlled
	Intention to use EPCM	
G1	النية صرف الادوية المراقبة المتابعة حالياً باحتاجة الي تطوير The currently used controlled medications dispensing mechanism needs development	[9]
G2	سأقوم باستخدام الوصف الالكتروني للأدوية المراقبة إذا تم توفيره I will use the electronic prescribing for controlled medications if it is available	[34]

References

[1] B. Clyne, M.C. Bradley, C. Hughes, T. Fahey, K.L. Lapane, Electronic Prescribing and Other Forms of Technology to Reduce Inappropriate Medication Use and Polypharmacy in Older People: A Review of Current Evidence, Clin. Geriatr. Med. 28 (2) (2012) 301–322, https://doi.org/10.1016/j.cger.2012.01.009.

[2] P. Donyai, K. O'Grady, A. Jacklin, N. Barber, B.D. Franklin, The effects of electronic prescribing on the quality of prescribing, Br. J. Clin. Pharmacol. 65 (2) (2008) 230–237.

[3] E. Ammenwerth, P. Schnell-Inderst, C. Machan, U. Siebert, The Effect of Electronic Prescribing on Medication Errors and Adverse Drug Events: A Systematic Review, J. Am. Med. Inf. Assoc. 15 (5) (2008) 585–600.

[4] N. Roumeliotis, J. Sniderman, T. Adams-Webber, N. Addo, V. Anand, P. Rochon, A. Taddio, C. Parshuram, Effect of Electronic Prescribing Strategies on Medication Error and Harm in Hospital: a Systematic Review and Meta-analysis, J. Gen. Intern. Med. 34 (10) (2019) 2210–2223.

[5] R.E. Hoyt, M. Sutton, A. Yoshihashi, Medical Informatics Practical Guide for the Healthcare Professional. 2009.

[6] D. Bell, S. Straus, D. Belson, S. Wu, D. Green, and J. Crosson, A Toolset for E-Prescribing Implementation in Physician Offices, AHRQ Publ., no. 11, 2011, Accessed: Apr. 15, 2022. [Online]. Available: www.ahrq.gov.

[7] A. Porterfield, K. Engelbert, A. Coustasse, Electronic prescribing: improving the efficiency and accuracy of prescribing in the ambulatory care setting, Perspect. Health Inf. Manag. 11 (Spring) (2014). Accessed: May 03, 2022. [Online]. Available: /pmc/articles/PMC3995494/.

[8] M.P. Tully, Prescribing errors in hospital practice, Br. J. Clin. Pharmacol. 74 (4) (Oct. 2012) 668–675, https://doi.org/10.1111/j.1365-2125.2012.04313.x.

[9] C.P. Thomas, M. Kim, A. McDonald, P. Kreiner, S.J. Kelleher, M.B. Blackman, P. N. Kaufman, G.M. Carrow, Prescribers' expectations and barriers to electronic prescribing of controlled substances, J. Am. Med. Informatics Assoc. 19 (3) (2012) 375–381.

[10] P. Esmaeil Zadeh, M.C. Tremblay, A review of the literature and proposed classification on e-prescribing: Functions, assimilation stages, benefits, concerns, and risks, Res. Soc. Adm. Pharm. 12 (1) (2016) 1–19, https://doi.org/10.1016/j.sapharm.2015.03.001.

[11] C. Keyworth, J. Hart, C.J. Armitage, M.P. Tully, What maximizes the effectiveness and implementation of technology-based interventions to support healthcare professional practice? A systematic literature review, BMC Med. Inform. Decis. Mak. 18 (1) (Nov. 2018), https://doi.org/10.1186/s12911-018-0661-3.

[12] CDC, "Doctor Shopping Laws Issue Brief," vol. 2011, no. 2000, pp. 41–48, 2015, Accessed: Apr. 29, 2022. [Online]. Available: http://wonder.cdc.gov.

[13] AHRQ, "Medical Expenditure Panel Survey Topics," *meps.ahrq.gov*, 2017. https://www.meps.ahrq.gov/mepsweb/data_stats/MEPS_topics.jsp?topicid=14Z-1 (accessed Apr. 29, 2022).

[14] UNODC, "GLOBAL UPDATE: Understanding the global opioid crisis," 2019.

[15] C.L. Mattson, L.J. Tanz, K. Quinn, M. Kariisa, P. Patel, N.L. Davis, Trends and Geographic Patterns in Drug and Synthetic Opioid Overdose Deaths — United States, 2013–2019, MMWR. Morb. Mortal. Wkly. Rep. 70 (6) (Feb. 2021) 202–207, https://doi.org/10.15585/mmwr.mm7006a4.

[16] CDC, "Prescription Drug Monitoring Programs (PDMPs) | Drug Overdose | CDC Injury Center," *CDC*, 2022. https://www.cdc.gov/drugoverdose/pdmp/index.html (accessed Jun. 07, 2022).

[17] C.R. Dormuth, T.A. Miller, A. Huang, M.M. Mamdani, D.N. Juurlink, Effect of a centralized prescription network on inappropriate prescriptions for opioid analgesics and benzodiazepines, CMAJ 184 (16) (Nov. 2012) E852, https://doi.org/10.1503/cmaj.120465.

[18] "Doctor Shopping Laws | Prevention Solutions@EDC." https://preventionsolutions.edc.org/services/resources/doctor-shopping-laws (accessed Apr. 29, 2022).

[19] C.P. Thomas, M. Kim, S.J. Kelleher, R.V. Nikitin, P.W. Kreiner, A. McDonald, G. M. Carrow, Early experience with electronic prescribing of controlled substances in a community setting, J. Am. Med. Informatics Assoc. 20 (e1) (2013) e44–e51.

[20] M.P. Gagnon, É.R. Nsangou, J. Payne-Gagnon, S. Grenier, C. Sicotte, Barriers and facilitators to implementing electronic prescription: A systematic review of user groups' perceptions, J. Am. Med. Inform. Assoc. 21 (3) (2014) 535–541, https://doi.org/10.1136/amiajnl-2013-002203.

[21] R.Z. Oktarlina, E-prescribing: Benefit, barrier, and adopting challenge in electronic prescribing, J. Med. 21 (2) (2020) 98–101, https://doi.org/10.3329/jom.v21i2.50213.

[22] A. Hahn, A. Lovett, Electronic Prescribing: An Examination of Cost Effectiveness, Clinician Adoption and Limitations, Univers. J. Clin. Med. 2 (1) (2014) 1–24, https://doi.org/10.13189/ujcm.2014.020101.

[23] C.M. Cusack, Electronic Health Records and Electronic Prescribing: Promise and Pitfalls, Obstet. Gynecol. Clin. N. Am. 35 (1) (Mar. 2008) 63–79, https://doi.org/10.1016/j.ogc.2007.12.010.

[24] K.H. Dansky, L.D. Gamm, J.J. Vasey, C.K. Barsukiewicz, Electronic medical records: Are physicians ready? J. Healthc. Manag. 44 (6) (1999) 440–455, https://doi.org/10.1097/00115514-199911000-00007.

[25] K.A. Wager, F.W. Lee, J.P. Glaser, Health Care Information Systems A Practical Approach for Health Care Management. 2017.

[26] E.L. Crisan, A. Mihaila, Health-care information systems adoption – a review of management practices, Vilakshan - XIMB J. Manag. 20 (1) (2023) 130–139.

[27] Centers for Disease Control and Prevention (US), "Integrating & Expanding Prescription Drug Monitoring Program Data: Lessons from Nine States," no. February, p. 13, 2017, Accessed: May 09, 2022. [Online]. Available: https://www.cdc.gov/drugoverdose/pdf/pehriie_report-a.pdf.

[28] W.M. Sweileh, S.H. Zyoud, M.S. Al-Haddad, Pharmacy Practice in Palestine, vol. 253, no. Area C. Elsevier Inc., 2016. doi: 10.1016/B978-0-12-801714-2.00013-7.

[29] MOH, "تعليمات تداول الأدوية المخدرة و المؤثرات العقلية في المؤشرات الصيدلانية," 2012.

[30] T. Clark, J. Eadie, P. Knue, Prescription drug monitoring programs: an assessment of the evidence for best practices [Online].Available: Drug Monit. Progr. (2012) 95 https://www.ncjrs.gov/App/Publications/abstract.aspx?ID=265339.

[31] L. Graf-Vlachy and K. Buhtz, Social influence in technology adoption research: A literature review and research agenda, in Proceedings of the 25th European Conference on Information Systems, ECIS 2017, 2017, pp. 2331–2351. Accessed: May 06, 2022. [Online]. Available: http://aisel.aisnet.org/ecis2017_rphttp://aisel.aisnet.org/ecis2017_rp/148.

[32] V. Venkatesh, M.G. Morris, G.B. Davis, F.D. Davis, User acceptance of information technology: Toward a unified view, MIS Q. Manag. Inf. Syst. 27 (3) (2003) 425–478, https://doi.org/10.2307/30036540.

[33] D.S. Palappallil, C. Pinheiro, Perceptions of prescribers towards electronic prescription: A pre-implementation evaluation, J. Young Pharm. 10 (3) (Jul. 2018) 313–317, https://doi.org/10.5530/jyp.2018.10.69.

[34] J. Cohen, J.-M. Bancilhon, M. Jones, South African physicians' acceptance of e-prescribing technology: an empirical test of a modified UTAUT model, South African Comput. J. 50 (Jul. 2013), https://doi.org/10.18489/sacj.v50i1.175.

[35] M.A. Saunders, P. Lewis, and A. Thornhill, *Research Methods for Business Students Eights Edition Research Methods for Business Students*. 2009. [Online]. Available: www.pearson.com/uk%0Ahttps://www.amazon.com/Research-Methods-for-Business-Students/dp/1292208783/ref=sr_1_2?dchild=1&qid=1614706531&refinements=p_27%3AAdrian+Thornhill+%2F+Philip+Lewis+%2F+Mark+N.+K.+Saunders&s=books&sr=1-2&text=Adrian+Thornhill+%2F+Phili.

[36] M. Alavi, D.C. Visentin, D.K. Thapa, G.E. Hunt, R. Watson, and M. Cleary, Exploratory factor analysis and principal component analysis in clinical studies: Which one should you use? J. Adv. Nurs., vol. 76, no. 8. John Wiley & Sons, Ltd, pp. 1886–1889, Aug. 01, 2020. doi: 10.1111/jan.14377.

[37] D. D. Suhr, "Principal component analysis vs. exploratory factor analysis," in *SUGI 30*, 2010, pp. 1–11. Accessed: May 12, 2023. [Online]. Available: http://0-search.ebscohost.com.library.regent.edu/login.aspx?direct=true&db=edsbas&AN=edsbas.ftciteseerx.oai.CiteSeerX.psu.10.1.1.176.1897&site=eds-live.

[38] L. Vinet, A. Zhedanov, Discovering Statistics Using IBM SPSS Statistics 5th Edition, J. Phys. A Math. Theor. 44 (8) (2011) 1689–1699, https://doi.org/10.1088/1751-8113/44/8/085201.

[39] G.H. Teferi et al., Perception of physicians towards electronic prescription system and associated factors at resource limited setting 2021: Cross sectional study, PLoS One, vol. 17, no. 3 March, 2022, doi: 10.1371/journal.pone.0262759.

[40] I.U. Khan, Y. Yu, Z. Hameed, S.U. Khan, and A. Waheed, Assessing the Physicians' Acceptance of E-Prescribing in a Developing Country: An Extension of the UTAUT Model With Moderating Effect of Perceived Organizational Support, J. Glob. Inf. Manag., vol. 26, no. 3, pp. 121–142, Jan. 2018, doi: 10.4018/JGIM.2018070109.

[41] E. Cody-Allen and R. Kishore, "An extension of the UTAUT model with e-quality, trust, and satisfaction constructs," in *SIGMIS CPR'06 - Proceedings of the 2006 ACM SIGMIS CPR Conference*, 2006, vol. 2006, pp. 82–89. doi: 10.1145/1125170.1125196.

[42] K.P. Gupta, P. Bhaskar, and S. Singh, Critical factors influencing E-government adoption in India: An investigation of the citizens' perspectives, J. Inf. Technol. Res., vol. 9, no. 4, pp. 28–44, Oct. 2016, doi: 10.4018/JITR.2016100103.

[43] A. Dash, A.K. Sahoo, Exploring patient's intention towards e-health consultation using an extended UTAUT model, J. Enabling Technol. 16 (4) (2022) 266–279.

[44] M.J. Wills, O.F. El-Gayar, and D. Bennett, Examining healthcare professionals' acceptance of electronic medical records using utaut, Issues Inf. Syst., vol. IX, no. 2, 2008, doi: 10.48009/2_iis_2008_396-401.

[45] M.S. Talukder, G. Sorwar, Y. Bao, J.U. Ahmed, M.A.S. Palash, Predicting antecedents of wearable healthcare technology acceptance by elderly: A combined SEM-Neural Network approach, Technol. Forecast. Soc. Change 150 (Jan. 2020), 119793, https://doi.org/10.1016/j.techfore.2019.119793.

[46] N. Magdi, PhD Thesiss ; Middlesex University Research Repository : Factors Affecting Adoption of eHealth in Egypt A thesis submitted to Middlesex University, 2013.

[47] S. Chimento-Díaz, P. Sánchez-García, C. Franco-Antonio, E. Santano-Mogena, I. Espino-Tato, S. Cordovilla-Guardia, Factors Associated with the Acceptance of New Technologies for Ageing in Place by People over 64 Years of Age, Int. J. Environ. Res. Public Health 19 (5) (Mar. 2022) 2947, https://doi.org/10.3390/ijerph19052947.

[48] J. Ha, H.K. Park, Factors affecting the acceptability of technology in health care among older korean adults with multiple chronic conditions: A cross-sectional study adopting the senior technology acceptance model, Clin. Interv. Aging 15 (2020) 1873–1881, https://doi.org/10.2147/CIA.S268606.