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What Drives Community Pharmacists' Intention to Provide Drive-Through Vaccination Services? A Theory of Planned Behavior–Based Structural Equation Modeling Study in the United Arab Emirates

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Abstract

Background

Limited evidence has examined community pharmacists' intention to provide drive-through vaccination services. This study examined factors associated with this intention among community pharmacists in the United Arab Emirates (UAE) using the Pharmacist-Driven Vaccination Service Intention Model (PDV-SIM).

Methods

A cross-sectional study was conducted among 428 community pharmacists in the UAE from May to December 2024. An Arabic-language questionnaire assessed six constructs: patient-related attitude (A1), personal development attitude (A2), attitude toward negative consequences (A3), subjective norm (SN), perceived behavioral control (PBC), and intention (INT). Confirmatory factor analysis and structural equation modeling were performed using robust maximum-likelihood estimation.

Results

The measurement model demonstrated acceptable reliability, convergent and discriminant validity, and overall model fit. Personal development attitude was the strongest positive predictor of intention (A2: β = 0.546, robust z = 5.807), followed by perceived behavioral control (PBC: β = 0.209, robust z = 3.368) and subjective norm (SN: β = 0.191, robust z = 3.829); all three paths were significant at $p < 0.001$. Patient-related attitude (A1: β = 0.033, robust z = 0.311) and attitude toward negative consequences (A3: β = 0.009, robust z = 0.175) were not significant predictors. The model explained 62.8% of the variance in intention ($R^2 = 0.628$).

Conclusion

Community pharmacists' intention to provide drive-through vaccination services was primarily associated with professional development, perceived behavioral control, and stakeholder support. Implementation strategies should therefore emphasize pharmacist training, organizational readiness, adequate resources, and professional and institutional support.

1. Introduction

Community pharmacists are playing a growing role in vaccination as the scope of pharmacy practice moves beyond medicine supply and increasingly includes preventive care and public health services. Community pharmacies are widely available, usually easy for patients to access, and often operate for longer hours than many conventional healthcare facilities. They also allow repeated contact with

patients without requiring scheduled appointments. These features position community pharmacies as important settings for improving access to immunization, especially for adults who may experience logistical, financial, or time-related barriers when using traditional healthcare services [1–3, 4]. Evidence from nations that have introduced pharmacist-administered vaccination shows that these services can be delivered in practice and are generally acceptable to both patients and pharmacists [2, 3, 5]. However, increased convenience does not automatically lead to consistent improvements in vaccination uptake. The effectiveness of pharmacy-based vaccination depends on how well the service is connected to existing immunization systems, how clearly it is supported by regulation, and how effectively it is implemented within individual pharmacy settings [1, 4].

For this reason, the implementation of pharmacist-led vaccination cannot be understood only in terms of pharmacists' willingness to administer vaccines. Community pharmacies must have trained personnel, adequate staffing levels, appropriate physical facilities, and clear practices for responding to vaccination-related negative outcomes. Pharmacists also operate within professional and regulatory systems in which physicians, patients, health authorities, nurses, and other stakeholders may either enable or restrict their expanded vaccination role. Research across different healthcare contexts has identified several factors that influence implementation, including training, workload, confidence, physical space, reimbursement, staffing, professional acceptance, and organizational support [5, 6, 7, 8, 9, 10]. These outcomes indicate that the introduction of a pharmacist-led vaccination service requires attention not only to pharmacists' attitudes toward vaccination but also to the operational conditions under which the service would be provided.

Drive-through vaccination offers another model for vaccine delivery. This approach became especially prominent during the COVID-19 pandemic, when healthcare systems were required to vaccinate large numbers of people while reducing crowding, waiting times, and avoidable face-to-face contact. Evidence from drive-through and other high-throughput vaccination models suggests that they can improve patient flow and increase access to vaccination in appropriate settings [11, 12]. However, most available evidence concerns drive-through vaccination as a mass-vaccination or public-health strategy, as opposed to a service delivered by or through community pharmacists. Demonstrating that drive-through vaccination can work operationally in large-scale public-health settings does not necessarily show that the same model can be readily transferred to routine community pharmacy practice.

This distinction matters because pharmacist participation in drive-through vaccination may involve different behavioral, professional, and organizational considerations from conventional pharmacist-administered vaccination. Pharmacists may identify clear patient benefits, including convenience, accessibility, and reduced waiting times. They may also see professional advantages associated with an expanded clinical and public-health role. Simultaneously, they may have apprehensions about capacity, professional boundaries, long-term sustainability, infrastructure, staffing, patient observation, and their capacity to manage adverse events safely. Their willingness to participate may also be shaped by the perceived expectations of physicians, nurses, government authorities, professional bodies, and other

stakeholders. General approval of pharmacist vaccination may consequently be inadequate to explain whether pharmacists expect to provide vaccination through a drive-through model.

Behavioral theory provides a useful structure for examining these issues. The Pharmacist-Driven Vaccination Service Intention Model (PDV-SIM), developed by Gülpınar and Uzun, utilizes the Theory of Planned Behavior within vaccination services in community pharmacy. The model was developed using confirmatory factor analysis, exploratory factor analysis, and structural equation modeling [13]. It identifies, subjective norms, professional-development attitudes, patient-related attitudes, attitudes toward potential negative consequences and perceived behavioral control as conceptually important measurements of pharmacists' vaccination-service intents. In the original structural model, behavioral intention was associated with attitude toward negative consequences, patient-related attitude, and subjective norm, while professional-development attitude and perceived behavioral control were not significant predictors [13]. These results provide a valuable theoretical foundation, but the strength and relevance of each determinant may vary across healthcare systems, regulatory environments, and service-delivery models.

The United Arab Emirates (UAE) provides a particularly relevant setting for examining this issue. Community pharmacists in the UAE have previously reported substantial willingness and readiness to increase their role in vaccination. One UAE study found that many community pharmacists supported pharmacist-administered vaccination, were ready to vaccinate if legally permitted, and were prepared to complete the training required to provide the service [14]. This evidence offers an important basis for considering wider pharmacist involvement in immunization. Nevertheless, willingness to vaccinate within a conventional community pharmacy setting cannot simply be assumed to apply to drive-through vaccination. A drive-through model may necessitate different workflows, facilities, staffing arrangements, patient-monitoring processes, and understandings of professional responsibility.

The existing literature consequently indicates a specific and practical research gap. Prior studies have explored pharmacists' readiness and behavioral intention, pharmacist-administered vaccination, barriers and facilitators to implementation, and drive-through vaccination as an alternative delivery strategy [1–14]. However, these areas of evidence have largely developed separately. There is a lack of studies that have specifically examined community pharmacists' behavioral intention to provide drive-through vaccination services, particularly in the UAE. This gap is significant because implementing a new service-delivery model needs more than an overall willingness to vaccinate. It necessitates comprehension of how pharmacists assess patient-related benefits, professional-development opportunities, potential negative outcomes, stakeholder expectations, and their own behavioral control, including capacity, confidence, and organizational resources.

Hence, the current study assessed community pharmacists' intent to offer drive-through vaccination facilities in the UAE using the PDV-SIM frame. Particularly, the study assessed the measurement properties of the PDV-SIM framework and used structural equation modeling to assess the correlation between patient-related attitude (A1), personal development attitude (A2), attitude toward negative

consequences (A3), subjective norm (SN), perceived behavioral control (PBC), and intention to provide drive-through vaccination services (INT). By testing these factors together within a latent-variable construction, the research aimed to delineate the behavioral and contextual dynamics associated with pharmacists' intent to take part in this alternative vaccination-delivery model. The findings are intended to provide evidence that may inform future service planning, regulatory preparation, and implementation strategies for drive-through pharmacist-led vaccination in the UAE.

2. Methods and Materials

2.1. Study design and setting

A cross-sectional study was conducted among community pharmacists practicing in the United Arab Emirates (UAE) to examine their intention to provide drive-through vaccination (PDV) services. Data collection was conducted from May to December 2024 using an Arabic-language online questionnaire distributed through a convenience sampling approach. The study evaluated the measurement properties of the proposed model using confirmatory factor analysis (CFA) and subsequently examined the hypothesized relationships among its constructs using structural equation modeling (SEM).

2.2. Study population and eligibility criteria

The target population comprised community pharmacists practicing in the UAE. Pharmacists were eligible to participate if they were currently working in a community pharmacy and had completed at least three months of professional practice. Pharmacists who were still undergoing their initial probationary period were excluded because they might have had limited exposure to routine community pharmacy practice and the local healthcare environment.

Participant characteristics collected for descriptive purposes included sex, educational level, pharmacy type, professional position, years of professional experience, and university of graduation.

2.3. Theoretical framework and study instrument

This study used an adapted version of the previously published Pharmacist-Driven Vaccination Service Intention Model (PDV-SIM) questionnaire, originally developed by Mehmet Gülpınar and Uzun. [13]. The instrument is based on the Theory of Planned Behavior (TPB) [15], which explains behavioral intention through attitudes toward the behavior, subjective norms, and perceived behavioral control. The questionnaire was therefore not developed de novo for the present study.

For the present study, the model was applied to the context of drive-through vaccination services. It comprised six latent constructs measured by 21 observed indicators: patient-related attitude toward PDV services (A1), personal development attitude toward PDV services (A2), attitude toward negative consequences of PDV services (A3), subjective norm regarding PDV services (SN), perceived behavioral control related to PDV services (PBC), and intention to provide PDV services (INT).

Patient-related attitude toward PDV services (A1) was measured using three items assessing whether providing PDV services could strengthen pharmacist–patient relationships, increase patients' trust in pharmacists, and improve patient satisfaction.

Personal development attitude toward PDV services (A2) comprised three items assessing perceived professional benefits, including increased professional satisfaction, professional knowledge, and professional skills.

Attitude toward negative consequences of PDV services (A3) was assessed using four items addressing concerns related to professional boundaries, increased workload, sustainability of the service, and potential undesirable patient consequences that might be difficult to manage within the pharmacy setting.

Subjective norm regarding PDV services (SN) comprised three items assessing pharmacists' perceptions of whether physicians, nurses, and government authorities would accept pharmacist involvement in PDV services.

Perceived behavioral control related to PDV services (PBC) was measured using five items assessing confidence in administering PDV services, confidence in managing potential adverse effects, adequacy of staffing, availability of qualified personnel, and adequacy of infrastructure and technical resources.

Intention to provide PDV services (INT) comprised three items assessing pharmacists' future intention to engage in PDV services, undertake the necessary training to qualify as a vaccinator, and provide the infrastructure required for PDV service delivery.

The questionnaire was adapted from the previously published PDV-SIM instrument [13]. The English version of the questionnaire used in the present study is provided in Supplementary File 1.

2.4. Study hypotheses

Based on the theoretical structure of the PDV-SIM and the TPB [15, 13], five direct relationships with pharmacists' intention to provide PDV services were hypothesized:

H1

Patient-related attitude toward PDV services (A1) is positively associated with intention to provide PDV services.

H2

Personal development attitude toward PDV services (A2) is positively associated with intention to provide PDV services.

H3

Attitude toward negative consequences of PDV services (A3) is negatively associated with intention to provide PDV services.

H4

Subjective norm regarding PDV services (SN) is positively associated with intention to provide PDV services.

H5

Perceived behavioral control related to PDV services (PBC) is positively associated with intention to provide PDV services.

Accordingly, A1, A2, A3, SN, and PBC were specified as exogenous latent constructs, whereas INT was specified as the endogenous latent construct.

2.5. Translation and cultural adaptation

The adapted questionnaire underwent forward and backward translation following established procedures for cross-cultural adaptation [16, 17]. Two bilingual translators independently translated the English questionnaire into Arabic. The translated versions were compared, discrepancies were discussed, and a reconciled Arabic version was produced.

The reconciled questionnaire was subsequently back-translated into English by two additional bilingual translators who had not been provided with the source questionnaire. The back-translated versions were compared with the English questionnaire to assess conceptual equivalence and preservation of the intended meaning. Any discrepancies were reviewed by the translators and research team until consensus was reached.

The Arabic version was subsequently reviewed for linguistic clarity, cultural appropriateness, and relevance to community pharmacy practice in the UAE.

2.6. Pilot study

Before the main survey, the Arabic questionnaire was pilot tested among 17 community pharmacists. Pilot participants were excluded from the final analytical sample. The pilot assessment examined item clarity, cultural appropriateness, questionnaire flow, and feasibility. The average completion time was approximately 15 minutes. Minor wording and formatting modifications were made based on participant feedback before the main survey was administered.

2.7. Sample size

The sample-size requirement was considered in relation to the planned CFA and covariance-based SEM analyses. The measurement model comprised 21 observed indicators across six latent constructs.

Based on the commonly used recommendation of approximately 10 participants per observed indicator, a minimum sample of 210 participants was considered adequate [18, 19].

The final analytical sample of 428 community pharmacists exceeded this minimum requirement and provided approximately 20 participants per observed indicator.

2.8. Data collection and quality assurance

Data collection took place from May to December 2024. An Arabic-language online questionnaire was distributed to eligible community pharmacists practicing in the UAE using a convenience sampling approach. Participation was voluntary, and potential participants were provided with information about the study before completing the questionnaire. Electronic informed consent was obtained before participants proceeded to the survey. A total of 428 eligible community pharmacists were included in the final analytical dataset.

Completed questionnaires were screened before analysis. Quality-control procedures included checks for duplicate submissions, unusually short completion times, and inconsistent response patterns. The questionnaire was anonymous, and no personally identifiable information was collected. Electronic study data were stored in password-protected databases accessible only to authorized members of the research team. Study findings were analyzed and reported in aggregate form to maintain participant confidentiality.

2.9. Ethical considerations

Ethical approval was obtained from the Institutional Ethical Review Committee of Ajman University. Participation was voluntary, and electronic informed consent was obtained before questionnaire completion. Participants were informed about the purpose of the study, confidentiality of their responses, and their right to discontinue participation without penalty. The study was conducted in accordance with applicable institutional ethical requirements and the principles of the Declaration of Helsinki.

2.10. Statistical analysis

Data were analyzed using IBM SPSS Statistics version 26 and EQS version 6.4. Categorical variables were summarized using frequencies and percentages. Data were screened for missing values, outliers, and distributional assumptions before SEM. Multivariate normality was assessed using Mardia's coefficient. Because multivariate non-normality was identified, CFA and SEM were performed using robust maximum likelihood (MLR) with Satorra–Bentler robust statistics.

The measurement model was evaluated using standardized factor loadings, Cronbach's alpha (α), composite reliability (CR), average variance extracted (AVE), and the Fornell–Larcker criterion for discriminant validity [20–23]. Values ≥ 0.70 for α and CR and ≥ 0.50 for AVE were considered acceptable. Model fit was assessed using the Satorra–Bentler scaled chi-square (SB-χ^2), NFI, NNFI/TLI, CFI, IFI, MFI, and RMSEA with its 90% confidence interval. Values around or above 0.90 for incremental fit indices and

RMSEA ≤ 0.08 were considered indicative of acceptable fit [24, 25]. A residual covariance between PBC1 and PBC2 was retained in the measurement and structural models.

The structural model was subsequently evaluated using covariance-based SEM to test the hypothesized effects of A1, A2, A3, SN, and PBC on INT. Standardized path coefficients (β) and robust test statistics were used for hypothesis testing, while R^2 was used to quantify the variance explained in INT. Statistical significance was set at $p < 0.05$.

3. Results

Demographic and professional characteristics

A total of 428 community pharmacists were included in the study, with complete data available for all demographic and professional characteristics presented in Table 1. Females represented a slightly larger proportion of the sample than males (55.6% vs 44.4%). Most participants held a bachelor's degree (75.9%), while 20.3% had a master's degree and 3.7% had a PhD. Participants were relatively evenly distributed between independent (53.7%) and chain pharmacies (46.3%). Regarding professional position, 60.0% were pharmacists in charge, 21.7% were assistant pharmacists, and 18.2% were chief pharmacists. Professional experience was concentrated mainly in the 6–10-year category (43.0%), followed by 1–5 years (29.0%) and 11–15 years (15.2%). Smaller proportions reported 16–20 years (5.8%), more than 20 years (4.2%), or less than one year (2.8%) of experience. Regarding university of graduation, 43.2% graduated from local universities, 30.6% from regional universities, and 26.2% from international universities.

Table 1
Demographic and professional characteristics of the study participants (N = 428)

Characteristic	Category	n	%
Gender	Female	238	55.6
	Male	190	44.4
Education level	Bachelor's degree	325	75.9
	Master's degree	87	20.3
	PhD	16	3.7
Pharmacy type	Chain pharmacy	198	46.3
	Independent pharmacy	230	53.7
Professional position	Assistant pharmacist	93	21.7
	Chief pharmacist	78	18.2
	Pharmacist in charge	257	60
Years of experience	Less than 1 year	12	2.8
	1–5 years	124	29
	6–10 years	184	43
	11–15 years	65	15.2
	16–20 years	25	5.8
	> 20 years	18	4.2
University of graduation	Local	185	43.2
	Regional	131	30.6
	International	112	26.2

Note. Data are presented as frequency (n) and percentage (%). Percentages may not total exactly 100% because of rounding.

Measurement Model Assessment and Construct Validity.

Before evaluating the measurement model, multivariate normality was assessed to determine the appropriate estimation method. Mardia's multivariate kurtosis coefficient was 267.41, with a normalized estimate of 88.99, indicating a substantial departure from multivariate normality. The Mardia-based kappa was 0.55, further supporting the presence of excess multivariate kurtosis. Robust maximum-likelihood estimation was therefore used for the CFA and subsequent SEM analyses. Accordingly,

interpretation of model fit focused primarily on the robust solution, including the Satorra–Bentler scaled chi-square and associated robust fit indices.

The six-factor measurement model showed acceptable, although not uniformly strong, fit to the data **(**Table 2 **and** Fig. 1**).** The Satorra–Bentler scaled chi-square was significant, $\chi^2(173) = 607.125$, $p < 0.001$. The CFI (0.901) and IFI (0.902) met the commonly applied threshold of 0.90, while the RMSEA was 0.077 (90% CI 0.070–0.083). In contrast, the NFI (0.868) and NNFI/TLI (0.880) remained below 0.90, and the upper confidence limit for the RMSEA was slightly above 0.08. Taken together, these indices indicated acceptable overall approximation but also suggested some remaining model–data discrepancy.

The measurement model included a correlated residual between PBC1 and PBC2 within the perceived behavioral control construct. The estimated residual covariance was 0.466, corresponding to a residual correlation of 0.639, and was statistically significant using the robust test ($z = 6.227$). This covariance was theoretically plausible because both indicators assess closely related aspects of pharmacists' perceived personal capability: PBC1 evaluates confidence in administering drive-through vaccination, whereas PBC2 evaluates confidence in managing potential vaccination-related adverse effects. In contrast, the remaining perceived behavioral control indicators primarily assess enabling organizational resources, including staffing and infrastructure. The correlated residual was therefore treated as shared indicator-specific variance within the same latent construct rather than as evidence of an additional structural relationship.

The measurement properties of the individual constructs were satisfactory **(**Table 3**).** Standardized factor loadings ranged from 0.604 to 0.952, with most indicators exceeding 0.70. Q12 had the lowest loading ($\lambda = 0.604$), while Q23 was marginally below 0.70 ($\lambda = 0.695$). Neither finding alone warranted indicator removal because both items retained substantive relevance and their respective constructs demonstrated adequate reliability and convergent validity. Cronbach's alpha coefficients ranged from 0.861 to 0.933, and composite reliability values ranged from 0.859 to 0.934. All values exceeded the recommended threshold of 0.70. AVE values ranged from 0.610 to 0.824 and were above 0.50 for every construct, providing support for convergent validity.

Discriminant validity was examined using the Fornell–Larcker criterion **(**Table 4**).** The square roots of AVE ranged from 0.781 to 0.908 and exceeded the absolute inter-construct correlations for all six latent variables. The strongest relationship was observed between patient-related attitude and personal development attitude ($r = 0.838$). Although this correlation indicates substantial overlap between the two positive-attitude dimensions, it remained below the square root of AVE for both patient-related attitude (0.868) and personal development attitude (0.908). The Fornell–Larcker criterion was therefore satisfied for all constructs. Overall, the findings supported the internal consistency, convergent validity, and discriminant validity of the six-factor measurement model.

Table 2
Model-Fit Indices for the PDV-SIM Measurement Model

Fit index	Robust value	Recommended criterion*	Interpretation
Satorra–Bentler scaled χ^2	607.125	—	—
df	173	—	—
p value	< 0.001	> 0.05 desirable	Significant
Satorra–Bentler scaling factor	0.597	—	Adjustment for non-normality
NFI	0.868	≥ 0.90	Below recommended criterion
NNFI/TLI	0.88	≥ 0.90	Below recommended criterion
CFI	0.901	≥ 0.90	Acceptable
IFI	0.902	≥ 0.90	Acceptable
MFI	0.602	—	Reported descriptively
RMSEA	0.077	≤ 0.08	Acceptable
RMSEA 90% CI	0.070–0.083	—	Upper bound slightly > 0.08

Note. CFI = comparative fit index; IFI = incremental fit index; MFI = McDonald's fit index; NFI = normed fit index; NNFI/TLI = non-normed fit index/Tucker–Lewis index; RMSEA = root mean square error of approximation. Robust fit statistics are presented because robust maximum-likelihood estimation was used.

Table 3
Reliability and Convergent Validity of the PDV-SIM Measurement Model

Factors	Item	Standardized loading	AVE	CR	Cronbach's alpha	R^2
Patient-related attitude (A1)	PRA1	0.791	**0.753**	**0.901**	**0.899**	0.626
	PRA2	0.921				0.849
	PRA3	0.886				0.785
Personal development attitude (A2)	PDA1	0.88	**0.824**	**0.934**	**0.931**	0.774
	PDA2	0.928				0.862
	PDA3	0.915				0.836
Negative consequences attitude (A3)	NCA1	0.604	**0.61**	**0.859**	**0.861**	0.365
	NCA2	0.879				0.773
	NCA3	0.701				0.491
	NCA4	0.901				0.811
Subjective norm (SN)	SN1	0.808	**0.748**	**0.899**	**0.896**	0.652
	SN2	0.898				0.806
	SN3	0.886				0.785
Perceived behavioral control (PBC)	PBC1	0.695	**0.722**	**0.927**	**0.933**	0.484
	PBC2	0.735				0.541
	PBC3	0.952				0.906
	PBC4	0.928				0.862
	PBC5	0.905				0.82
Intention (INT)	INT1	0.862	**0.802**	**0.924**	**0.923**	0.743
	INT2	0.906				0.82
	INT3	0.918				0.843

Note. CR = composite reliability; AVE = average variance extracted; PDV = drive-through vaccination. Standardized loadings were obtained directly from the CFA standardized solution

Table 4
Discriminant Validity Using the Fornell–Larcker Criterion

Construct	A1	A2	A3	SN	PBC	INT	Criterion
A1	**0.868**						Satisfied
A2	0.838	**0.908**					Satisfied
A3	−0.298	−0.139	**0.781**				Satisfied
SN	0.533	0.449	−0.335	**0.865**			Satisfied
PBC	0.46	0.319	−0.573	0.537	**0.85**		Satisfied
INT	0.686	0.725	−0.261	0.563	0.496	**0.896**	Satisfied

Note. Bold diagonal values represent the square root of AVE (√AVE) calculated from the AVE values in Table 2. Off-diagonal values represent the latent-factor correlations reported in the CFA model. A1 = patient-related attitude; A2 = personal development attitude; A3 = attitude toward negative consequences; SN = subjective norm; PBC = perceived behavioral control; INT = intention toward providing PDV services.

According to the Fornell–Larcker criterion, discriminant validity is supported when the square root of AVE for each construct exceeds the absolute value of its correlations with other constructs. All six constructs satisfy this criterion.

Structural Model Evaluation and Hypothesis Testing

The structural model was estimated using the robust approach because multivariate non-normality had been established in the preceding measurement-model assessment. The model produced a Satorra–Bentler scaled $\chi^2(173)$ of 607.108, $p < 0.001$, with a scaling factor of 0.597. The CFI was 0.901, IFI was 0.902, NNFI/TLI was 0.880, NFI was 0.868, and RMSEA was 0.077 (90% CI 0.070–0.083). Thus, CFI and IFI reached the commonly used 0.90 criterion and RMSEA remained below 0.08, whereas NNFI/TLI and NFI were below 0.90. Consistent with the measurement-model assessment, these results indicate an acceptable but not uniformly strong overall model fit **(**Table 5 **and** Fig. 2**).**

The structural paths showed that three of the five proposed predictors were significantly associated with pharmacists' intention to provide drive-through vaccination services **(**Table 6 **and** Fig. 2**).** Personal development attitude (A2) had the strongest association with intention (β = 0.546, robust $z = 5.807$, $p < 0.05$). Perceived behavioral control (PBC) was also positively associated with intention (β = 0.209, robust $z = 3.368$, $p < 0.05$), as was subjective norm (SN) (β = 0.191, robust $z = 3.829$, $p < 0.05$). In contrast, patient-related attitude (A1) had a small and non-significant association with intention (β = 0.033, robust $z = 0.311$), while attitude toward negative consequences (A3) also showed a negligible and non-significant association (β = 0.009, robust $z = 0.175$). Therefore, the hypotheses concerning A2, SN, and PBC were supported, whereas the hypothesized effects of A1 and A3 were not supported.

Importantly, the five predictors jointly explained 62.8% of the variance in intention ($R^2 = 0.628$). This indicates that the proposed model accounts for a substantial proportion of variation in pharmacists'

intention to engage in PDV services. The standardized structural equation was:

INT = 0.033(A1) + 0.546(A2) + 0.009(A3) + 0.191(SN) + 0.209(PBC) + εINT

R^2 = 0.628

Table 5
Model Fit Indices for the Structural Model (SEM)

Fit index	Value	Recommended criterion*	Interpretation
Satorra–Bentler scaled χ^2	607.108	—	—
Degrees of freedom	173	—	—
p value	< 0.001	> 0.05 desirable	Significant
Satorra–Bentler scaling factor	0.597	—	Robust correction applied
NFI	0.868	≥ 0.90	Below criterion
NNFI/TLI	0.88	≥ 0.90	Below criterion
CFI	0.901	≥ 0.90	Acceptable
IFI	0.902	≥ 0.90	Acceptable
MFI	0.602	—	Reported descriptively
RMSEA	0.077	≤ 0.08	Acceptable
RMSEA 90% CI	0.070–0.083	—	Upper bound slightly > 0.08

Note. CFI = comparative fit index; IFI = incremental fit index; MFI = McDonald's fit index; NFI = normed fit index; NNFI/TLI = non-normed fit index/Tucker–Lewis index; RMSEA = root mean square error of approximation. Robust fit statistics are presented because robust maximum-likelihood estimation was used.

Table 6
Structural Model Results and Hypothesis Testing for the PDV-SIM

Hypothesis	Structural relationship	Standardized β	Robust SE	Robust z	Direction hypothesized	Result
H1	A1 → INT	0.033	0.101	0.311	Positive	Not supported
H2	A2 → INT	0.546	0.094	**5.807**	Positive	Supported
H3	A3 → INT	0.009	0.059	0.175	Negative	Not supported
H4	SN → INT	0.191	0.045	**3.829**	Positive	Supported
H5	PBC → INT	0.209	0.066	**3.368**	Positive	Supported

Note. A1 = patient-related attitude toward PDV services; A2 = personal development attitude toward PDV services; A3 = attitude toward negative consequences of PDV services; SN = subjective norm; PBC = perceived behavioral control; INT = intention toward providing PDV services; β = standardized structural coefficient; SE = standard error. Statistical decisions are based on the robust test statistics reported by EQS. The structural predictors explained 62.8% of the variance in INT ($R^2 = 0.628$).

4. Discussion

This study investigated the variables associated with community pharmacists' intention to offer drive-through vaccination services in the UAE, using the Pharmacist-Driven Vaccination Service Intention Model (PDV-SIM) as the guiding framework. Of the five hypothesized determinants included in the model, three were significantly correlated with intention. Personal development attitude (A2), subjective norm (SN), and perceived behavioral control (PBC) significantly predicted pharmacists' intention to provide the service, whereas patient-related attitude (A1) and attitude toward negative consequences (A3) were not significant predictors. The framework explained 62.8% of the variance in intention, demonstrating strong explanatory capacity. On the whole, these findings indicate that pharmacists' willingness to take part in drive-through vaccination is shaped more by perceived professional development, perceived capability and available resources, and support from related professional and institutional participants than by perceived patient benefits or concerns about possible negative outcomes.

The significant effect of personal development attitude is one of the most important findings of this study. Pharmacists who viewed drive-through vaccination as a means of improving professional satisfaction, expanding knowledge, and developing new skills were more probable to intend to provide the service. This indicates that pharmacists may not regard drive-through vaccination only as an additional responsibility or workload demand. Instead, they may see it as an opportunity to broaden their clinical contribution and strengthen their role in public health. Similar themes have been reported in the wider pharmacist vaccination literature. In Malaysia, community pharmacists showed high disposition to provide vaccination services, yet lack of vaccination training was identified as a major barrier to implementation. The authors therefore emphasized the importance of training and operational guidance

before service introduction [26]. Evidence from Nigeria has also shown strong willingness among pharmacists to participate in vaccination, despite notable gaps in training and vaccine-specific infrastructure [27]. Taken together, these findings indicate that professional development and expertise building are central to how pharmacists evaluate expanded vaccination roles.

The value of personal development in this study contrasts with the original PDV-SIM developed by Gülpınar and Uzun, where personal development attitude was not a significant predictor of behavioral intention [13]. In the original study, patient-related attitude, attitude toward negative consequences, and subjective norm were significant determinants, while personal development attitude and perceived behavioral control were not. The difference between the present findings and the original model may reflect variation in both healthcare context and the specific vaccination model being examined. Drive-through vaccination may require pharmacists to develop competencies beyond those needed for conventional pharmacy-based vaccination. These may include new workflows, patient flow management, interprofessional coordination, emergency procedures, and service delivery outside the usual pharmacy consultation space. For this reason, professional development may become more influential when pharmacists are considering a newer and more operationally demanding vaccination model.

The UAE context may also help explain the prominence of personal development attitude. Prior research among UAE community pharmacists found substantial willingness to expand pharmacists' vaccination role. Thomas et al. reported that 68.4% of respondents were willing to administer vaccines if local regulations permitted it, and 81.8% were willing to complete the training needed to provide vaccines in their pharmacies [14]. The present study extends this earlier evidence by showing that perceived professional development is associated with intention when the specific service under consideration is drive-through vaccination. Training may therefore serve two connected functions. It equips pharmacists with the knowledge and skills required for safe service delivery, and it may also strengthen the perception that participation offers significant professional advancement.

Perceived behavioral control was also significantly correlated with intention. Pharmacists who felt confident administering vaccines, managing potential adverse effects, and working within a setting with sufficient qualified personnel, staffing, and appropriate infrastructure were more likely to intend to provide drive-through vaccination. This finding has a clear practical meaning. A service that depends on physical space, staffing arrangements, emergency preparedness, technical equipment, and coordinated workflow is likely to be attractive to pharmacists only when they believe that implementation is realistically achievable. Evidence from community pharmacy vaccination research supports this finding. Prior studies have identified training, facilities, staffing, equipment, financial resources and organizational resources as significant barriers or facilitators of vaccination-service implementation [6, 7, 8, 27]. In Nigeria, for instance, pharmacists expressed strong willingness to vaccinate, but many pharmacies lacked vaccine-related equipment, cold-chain resources, anaphylaxis-response kits, and guidance for managing anaphylaxis [27]. This shows that willingness to expand professional practice

does not inevitably mean that pharmacists see themselves or their dispensaries as operationally prepared.

The positive effect of PBC is also important in theory because it differs from the original PDV-SIM, in which PBC did not significantly forecast intention [13]. This distinction is plausible given the nature of drive-through vaccination. Compared with conventional vaccination within a pharmacy, a drive-through model places greater emphasis on staff coordination, physical layout, patient movement, clinical equipment, and the rapid management of unexpected events. The present finding consequently indicates that perceived control may become especially important when the proposed service has substantial organizational and logistical constraints. Rather than weakening the original PDV-SIM, this difference indicates that the relative strength of its determinants may change according to the type of vaccination service and the healthcare setting in which the framework is applied.

Subjective norm was the third meaningful determinant of intention. Pharmacists who were of the perception that nurses, physicians, and government authorities would accept drive-through vaccination had a higher likelihood of developing an intention to offer the service. Unlike the findings for A2 and PBC, this result is aligned with the original PDV-SIM, where subjective norm also significantly predicted intention [13]. The consistency between the two studies supports the analysis that professional and institutional acceptance is important when pharmacists consider taking on an expanded vaccination role. Pharmacist-led vaccination is not delivered in isolation from the wider healthcare practice. Clear regulatory authorization, professional recognition, and collaboration with other healthcare providers may decrease uncertainty about scope of practice and increase pharmacists' confidence that the service will be adopted. On the contrary, perceived resistance from other professionals may hinder adoption even when pharmacists personally support the idea. This interpretation aligns with implementation research showing that professional relationships and external support influence pharmacist-led vaccination [5, 8, 27]. The Nigerian research, for instance, identified a clash with other healthcare professionals as one of the barriers to vaccination provision [27].

In contrast, patient-related attitude did not independently predict intention. This should not be interpreted to mean that pharmacists viewed patient benefits as irrelevant. The construct included perceived benefits such as strengthening pharmacist-patient relationships, increasing patient trust in pharmacists, and improving patient satisfaction. The non-significant path indicates that, once the other factors were included in the model, differences in patient-related attitudes did not clarify additional differences in intention. Previous research has shown that pharmacists commonly recognize the accessibility and public-health value of pharmacy-based vaccination. For instance, 81.9% of Malaysian community pharmacists in one research study were in agreement that community pharmacies are accessible to the public, while 73.4% believed pharmacist contribution could improve vaccination coverage [26]. UAE community pharmacists have also shown substantial support for expanding their vaccination role [14]. Patient-related benefits may consequently represent a widely accepted reason for pharmacist vaccination, rather than the factor that differentiates pharmacists with stronger or weaker intention to participate in drive-through vaccination.

The non-significant A1 path is a further important difference from the original PDV-SIM, where patient-related attitude significantly predicted intention [13]. One possible explanation is that drive-through vaccination changes the nature of the decision pharmacists are making. If pharmacists already accept that vaccination can benefit patients, their intention to participate in a drive-through model may depend less on the general value of vaccination and more on whether the service can be delivered safely and realistically. In this context, the more influential questions may concern professional competence, infrastructure, staffing, workflow, and institutional support. This interpretation is consistent with the significant effects of personal development attitude and PBC in the present model. However, because the study used a cross-sectional design, this explanation should be treated as interpretive rather than causal.

Attitude toward negative consequences was also not significantly correlated with intention. Pharmacists may still have concerns about workload, professional boundaries, sustainability, or management of detrimental patient outcomes, but these concerns did not independently predict intention when the alternative constructs were considered simultaneously. This finding differs from the original PDV-SIM, where attitude toward negative consequences was a significant determinant [13]. The wider literature nonetheless confirms that concerns about vaccination implementation are real and practically important. Research has identified insufficient staffing, limited infrastructure, inadequate training, safety concerns, professional conflict and financial constraints as barriers to pharmacist-led vaccination [6, 7, 8, 26, 27]. Malaysian pharmacists reported lack of training and concerns about sustaining patient safety as barriers [26], while Nigerian pharmacists identified a lack of funding for storage equipment, insufficient training, professional conflicts, patient-safety concerns, and vaccine-handling problems [27].

One potential explanation for the non-significant A3 path is that apprehension about negative consequences may be partly offset by pharmacists' perceived behavioral control. For example, worries about workload, adverse-event management, or service sustainability may become less instrumental when pharmacists believe that qualified staff, suitable infrastructure, and adequate professional competence are accessible. The significant PBC path is consistent with this interpretation. However, the current model did not test mediation or other explanatory mechanisms linking A3 and PBC. This explanation should therefore be understood as a plausible interpretation as opposed to a confirmed causal pathway.

Taken in combination, comparison with the original PDV-SIM suggests that the relative significance of the model's determinants may depend on context. Subjective norm was significant in both studies, but the other relationships contrasted. In the UAE drive-through vaccination context, personal development attitude and PBC were significant predictors of intention, while patient-related attitude and attitude toward negative consequences were not. These outcomes support the conceptual usefulness of the PDV-SIM while cautioning against assuming that its structural paths will remain stable across healthcare systems or vaccination-delivery models. This is a key contribution of the present study. It shows that behavioral determinants identified for pharmacist-driven vaccination in general may operate in a

different way when pharmacists assess a specific and operationally distinct service model such as drive-through vaccination.

The framework explained 62.8% of the variance in intention, indicating that the five constructs captured a substantial proportion of differences in pharmacists' intention to offer drive-through vaccination. From an implementation point of view, the pattern of significant predictors is as important as the overall explanatory power of the model. Strategies to support future drive-through vaccination should not focus only on communicating possible patient benefits. Instead, the findings point to three priorities: professional development, implementation capacity, and stakeholder support. Training interventions should address vaccine administration, recognition and administration of adverse events, patient screening, drive-through workflow, documentation, and emergency practices. Pharmacies that participate in the initiative would also need adequate staffing, qualified personnel, suitable physical infrastructure, and appropriate clinical equipment. Data from other countries shows that strong keenness to vaccinate may not be enough if these operational conditions are absent [26, 27].

The significance of subjective norm also has consequences for professional organizations and policymakers. Clear regulatory guidance and evident support from health agencies may reinforce pharmacists' perception that drive-through vaccination is an accepted part of their professional role. Engagement with nurses and physicians should also be built into implementation planning from the outset, as opposed to being addressed only after the service is introduced. The objective should not be to displace existing vaccination providers but to examine whether community pharmacists can add to established immunization services through a further delivery pathway route Any future implementation should, therefore, be developed within an incorporated framework that defines professional responsibilities, referral pathways, documentation obligations, emergency processes, and communication between contributing healthcare providers.

These implications are especially relevant in the UAE. Prior UAE research has shown that many community pharmacists are willing to administer vaccines and complete the required training [14]. The current study builds on that evidence by extending beyond overall willingness and analyzing why pharmacists may develop an intention to take part in a specific alternative vaccination-delivery approach. The conclusions imply that positive attitudes toward vaccination in isolation may not be sufficient. Intention appears to depend more intensely on whether pharmacists perceive professional value in participation, feel that they have sufficient control over implementation, and sense support from essential stakeholders. These components provide more precise targets for the evaluation of feasibility, professional preparation, and future service planning.

Numerous strengths should be taken into consideration when interpreting the outcomes. The study focused on a clearly defined and relatively underexplored service framework as opposed to examining pharmacists' attitudes toward vaccination in broad terms. It applied a theory-informed model and assessed the measurement model before assessing the hypothesized structural relationships. Robust maximum-likelihood estimation was employed to address multivariate non-normality. The analytical

sample of 428 community pharmacists also allowed multiple latent constructs and their relationships to be examined simultaneously. In addition, comparison with the original PDV-SIM offered insight into which determinants may remain stable and which may change when the model is applied in a different healthcare context and to a different service configuration.

The current study also has limitations that are of note. First, the cross-sectional design does not allow causal inference, even though the structural model specified directional relationships. Second, intention was self-reported and should not be treated as the same as actual involvement in a future drive-through vaccination program. Third, convenience sampling may have produced selection bias if pharmacists with stronger interest in vaccination were more likely to take part. Fourth, the study was conducted among community pharmacists in the UAE, and the findings may not apply directly to countries with different policies, pharmacy infrastructures, workforce models, or vaccination regulations. Finally, while the model explained a significant fraction of variance in intention, other influences not included in the PDV-SIM may also influence implementation. These include reimbursement, vaccine supply legal liability, cold-chain requirements, information-system integration, management support, and patient demand. These factors should be evaluated before behavioral intention is translated into service implementation.

Future research should consequently extend beyond cross-sectional assessment of intention and examine whether the determinants identified in this study predict genuine adoption and sustained provision of drive-through vaccination. Future studies conducted alongside pilot programs would be especially useful for verifying whether training, infrastructure, and stakeholder support lead to pharmacist participation in practice. Qualitative studies could also help explain why personal development attitude and PBC were more important in the present UAE study than in the original PDV-SIM. Future evaluations should include service-level outcomes such as acceptability, feasibility, waiting time, vaccination throughput, staffing requirements, patient satisfaction, adverse-event management, and budgets. External validation of the framework in other countries and healthcare systems would also help ascertain which structural correlations are specific to the UAE drive-through vaccination context and which are reproducible across settings.

Conclusion

Community pharmacists' intention to offer drive-through vaccination services in the UAE was shaped by three significant determinants: personal development attitude, subjective norm, and perceived behavioral control. By contrast, patient-related attitude and attitude toward negative consequences did not independently explain intention once the other model constructs were considered. These findings support the broader relevance of the PDV-SIM while also extending it by showing that its structural pathways may vary when applied to a different healthcare context and a distinct vaccination-delivery model. The results suggest that general support for pharmacist-administered vaccination should not be assumed to translate automatically into readiness to adopt drive-through vaccination services. Future service planning should therefore give specific attention to pharmacists' perceived professional-development opportunities, their confidence in the practical feasibility of implementation, and the extent

of support from healthcare professionals, regulatory bodies, and institutional stakeholders. Overall, the findings provide a theory-informed basis for evaluating the feasibility of community pharmacist involvement in drive-through vaccination in the UAE. However, prospective and implementation-focused studies are still required before firm conclusions can be made regarding actual service adoption, sustainability, or effectiveness.

Declarations

Ethics and Consent to Participate declarations

Ethical approval was granted by the Institutional Ethical Review Committee at Ajman University. Participation was voluntary, and electronic informed consent was obtained before participants began the survey. The information provided to participants explained the study aims, procedures, possible risks, and possible benefits. Participants were also informed that they could withdraw at any point without penalty. All study procedures were conducted in line with the Declaration of Helsinki and relevant institutional requirements for research involving human participants.

Consent to Publish declaration

All authors agreed to the publication of this manuscript in the Journal of American Pharmacist Association.

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Declaration of generative AI and AI-assisted technologies in the writing process

Not applicable

Data availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Competing interests

All authors declare that they have no conflict of interest.

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CRediT authorship contribution statement

Ammar A. Jairoun: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Software, Visualization, Writing – original draft, Writing – review & editing.
Abeer M. Al-Ghananeem: Conceptualization, Methodology, Validation, Resources, Supervision, Project administration, Funding acquisition, Writing – review & editing.
Moyad Shahwan: Conceptualization, Methodology, Validation, Supervision, Writing – review & editing.

All authors reviewed and approved the final version of the manuscript and agreed to be accountable for their respective contributions.

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Figures

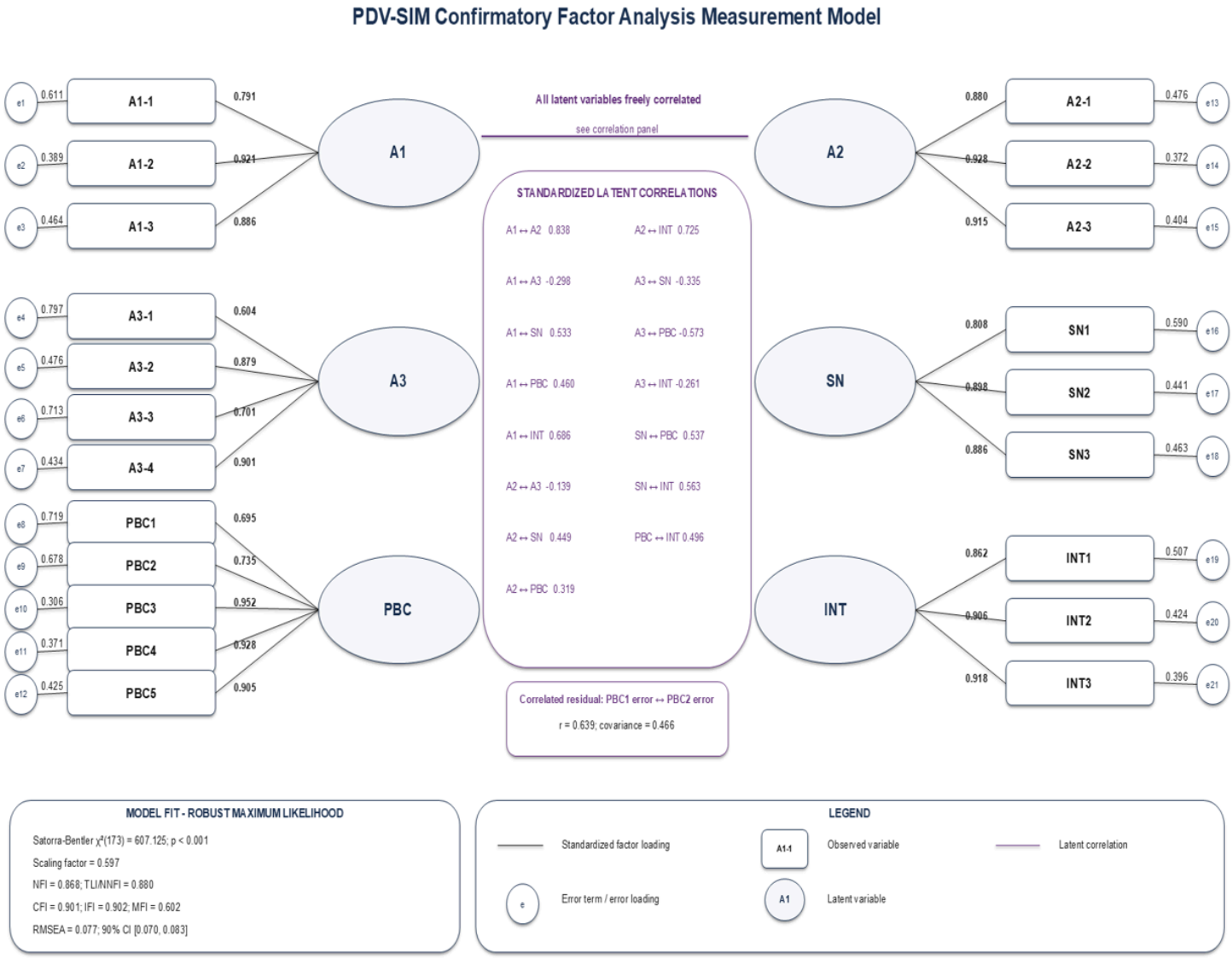

Figure 1

PDV-SIM Confirmatory Factor Analysis Measurement Model

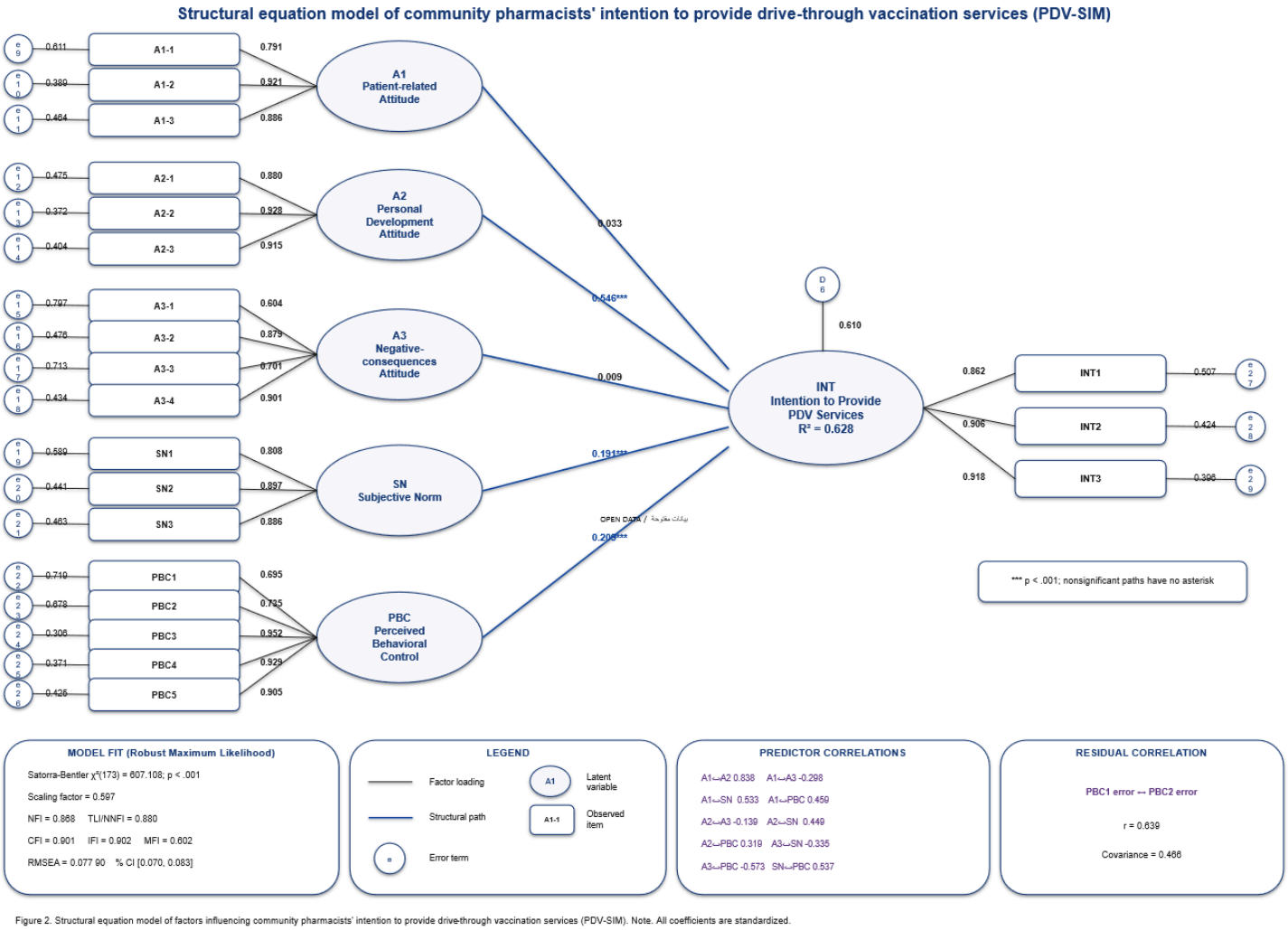

Figure 2. Structural equation model of factors influencing community pharmacists' intention to provide drive-through vaccination services (PDV-SIM). Note. All coefficients are standardized.

Figure 2

Structural equation model of community pharmacists' intention to provide drive-through vaccination services (PDV-SIM

Supplementary Files

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- SupplementaryFile1EnglishQuesti.docx