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ORIGINAL ARTICLE

Pilot Exploratory Factor Analysis of a Unified Theory of Acceptance and Use of Technology-Based Technology Acceptance Instrument for Virtual Antenatal Consultation

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ABSTRAK

Sektor kesihatan ibu dan anak (MCH) menunjukkan peningkatan penggunaan teknologi kesihatan digital, dengan penjagaan antenatal yang semakin mengintegrasikan perkhidmatan konsultasi maya (VC) bagi meningkatkan aksesibiliti, kesinambungan dan kualiti penjagaan untuk ibu mengandung. Kajian ini memfokuskan kepada pembangunan dan pengesahan awal sebuah instrumen yang diadaptasi bagi menilai penerimaan perkhidmatan VC dalam kalangan ibu antenatal, berasaskan model Unified Theory of Acceptance and Use of Technology yang diperluas serta menggabungkan konstruk kecekapan kendiri dan literasi kesihatan bagi mencerminkan faktor-faktor kontekstual yang relevan dalam penggunaan teknologi kesihatan digital oleh wanita hamil. Kajian rintis melibatkan 103 responden dari klinik kesihatan primer di Malaysia telah dijalankan, dan Analisis Faktor Eksploratori digunakan untuk menilai sifat psikometrik awal instrumen tersebut. Ujian kesferaan Bartlett adalah signifikan ($p < 0.01$), dan semua konstruk menunjukkan kecukupan persampelan yang memuaskan (KMO > 0.60). Pemuatan faktor melebihi 0.60 bagi semua item yang dikekalkan, manakala nilai alfa Cronbach melebihi 0.90, menunjukkan konsistensi dalaman yang sangat kuat. Namun demikian, nilai alpha yang terlalu tinggi perlu ditafsirkan secara berhati-hati kerana ia juga mungkin menunjukkan pertindihan item, yang akan dinilai semula dalam analisis pengesahan. Sebagai fasa pengukuran penerokaan, penemuan ini menyediakan bukti awal kejelasan konstruk dan bukannya pengesahan penuh. Instrumen ini menawarkan asas permulaan bagi menilai penerimaan VC dalam kalangan ibu antenatal, dengan pengesahan lanjut melalui Analisis Faktor Pengesahan dirancang untuk kajian utama seterusnya.

***Kata kunci**: Analisis faktor; antenatal; konsultasi maya; penerimaan teknologi; teknologi kesihatan digital*

ABSTRACT

The field of maternal and child health (MCH) is witnessing a growing adoption of digital health technologies, with antenatal care increasingly incorporating virtual consultation (VC) services to enhance accessibility, continuity and quality of care for expectant mothers. This study focuses on the development and preliminary validation of an adapted instrument designed to assess antenatal mothers' acceptance

of VC services, grounded in an extended Unified Theory of Acceptance and Use of Technology model and incorporating the construct of self-efficacy and health literacy to reflect key contextual factors relevant to digital healthcare use among pregnant women. A pilot study involving 103 respondents from Malaysian primary health clinics was conducted and Exploratory Factor Analysis was employed to examine the instrument's initial psychometric properties. Bartlett's test of sphericity was significant ($p < 0.01$), and all constructs demonstrated adequate sampling adequacy (KMO > 0.60). Factor loadings exceeded 0.60 for all retained items, and Cronbach's alpha values were above 0.90, indicating very strong internal consistency; however, these values were interpreted cautiously, as very high alpha may also indicate potential item redundancy, which will be evaluated in the subsequent confirmatory phase. As an exploratory measurement phase, the findings provide preliminary evidence of construct clarity rather than full validation. The instrument offers an initial foundation for assessing VC acceptance among antenatal mothers, with further validation through Confirmatory Factor Analysis planned in the subsequent main study.

Keywords: Antenatal; digital health technologies; factor analysis; technology acceptance; virtual consultation

INTRODUCTION

Rapid advancements in digital and communication technologies have transformed healthcare delivery worldwide (Stoumpos et al. 2023; World Health Organisation 2021). Digital health innovations, in particular, have been pivotal in reshaping healthcare industry practices and functions, leading to significant improvements in patient care and operational efficiency. These technological innovations are increasingly leveraged within the healthcare industry to enhance service delivery, address clinical challenges and maximise system-wide benefits. Their adoption has expanded across multiple clinical domains, particularly maternal health, where digital platforms support self-management, strengthen provider–patient interaction and improve maternal and child health (MCH) outcomes (Feroz et al. 2022; Güne Öztürk et al. 2024; Haddad et al. 2019). The COVID-19 pandemic further accelerated implementation as mobility restrictions and social distancing policies increased reliance on remote care modalities, positioning virtual solutions as essential tools for service continuity (Bahari et al. 2024; Müller et al. 2022; Palmer et al. 2021; Stamenova et al. 2022).

In maternal care, digital health solutions such as mobile applications, wearable devices and telehealth services improve clinical reach, reduce geographical barriers and support real-time decision-making for pregnant mothers (Bekker et al. 2023; Feroz et al. 2022; Ferrara et al. 2020; Nguyen et al. 2021). Virtual consultation (VC) represents a key modality within this digital landscape, serving as an integral component of telehealth that enables healthcare providers to deliver consultations, diagnoses and treatments remotely (Jemal et al. 2024 Perimal-Lewis et al. 2021). By extending clinical accessibility beyond physical facilities, VC is particularly valuable for underserved or geographically isolated mothers, offering continuity of care, reduced travel burden and improved access to professional support. It is increasingly recognised as an effective complement to traditional in-clinic antenatal services (Ishikawa et al. 2023; Orlando et al. 2019; Shmerling et al. 2022).

In Malaysia, VC services were first introduced in 2019 as part of the Ministry of Health's initiative to enhance accessibility and reduce congestion in primary health clinics. Initially piloted in five clinics for selected chronic disease patients, the VC programme expanded substantially during the COVID-19 pandemic to maintain continuity of care while reducing the need for in-person visits. Beginning in 2022, VC services were formally incorporated into MCH services, enabling

antenatal and postnatal mothers who meet clinical criteria to receive remote consultations as stated in the Bahagian Pembangunan Kesihatan Keluarga, Kementerian Kesihatan Malaysia (2022) and the Division of Family Health Development Ministry of Health Malaysia (2022). Since then, VC services have continued to expand across primary healthcare facilities, consistent with Malaysia's broader digital health agenda aimed at strengthening service delivery, improving healthcare access and enhancing operational efficiency, marking a major step toward digital transformation in Malaysia's primary healthcare delivery.

Despite these developments, uptake and utilisation among antenatal mothers remain underexamined, signalling the need to understand the determinants of VC acceptance in this population. More broadly, adoption of digital health continues to vary across populations and healthcare settings (Haimi 2023; Omboni et al. 2022), indicating the importance of examining context-specific acceptance factors. While prior studies show that users' acceptance of digital technologies contributes meaningfully to successful telehealth adoption (Philippi et al. 2021; Wu et al. 2024), such acceptance is shaped by broader structural and contextual conditions including digital infrastructure, system readiness and users' technological capabilities, positioning technology acceptance as only one component within a wider set of determinants influencing telehealth uptake (Alotaibi et al. 2025; Al-Qaysi et al. 2020; Hoque & Sorwar 2017).

Existing antenatal digital health research has largely focused on user experiences, feasibility or implementation, whereas experimental studies (e.g., randomised controlled trials and cohort designs) emphasise clinical outcomes rather than behavioural determinants of technology use (Mohamed et al. 2025). Moreover, studies on virtual care involving synchronous communication have predominantly been conducted in high-income countries, further limiting insights relevant to middle-income settings (Hofmann et al. 2022; Sassi et al. 2024). A clearer understanding of behavioural intention and acceptance determinants is therefore essential, particularly within the Malaysian antenatal care context, where validated tools for assessing VC acceptance remain limited. To address this gap, this study undertakes instrument development and pilot testing to support the measurement of antenatal mothers' acceptance of VC services.

Technology acceptance and usage models are commonly employed in studies to investigate the factors and barriers shaping technology acceptance, adoption and use in innovation contexts (Lee et al. 2025; Momani et al. 2017; Taherdoost 2018). Among established theoretical frameworks, the Unified Theory of Acceptance and Use of Technology (UTAUT) is widely applied in healthcare and demonstrates strong explanatory power for intention and system use (Duarte & Pinho 2019; Yu et al. 2021; Yu & Chen 2024). Research shows that performance expectancy, effort expectancy, social influence and facilitating conditions significantly influence technology adoption in maternal health settings (Hasibuan et al. 2022; Namatovu et al. 2021). Although UTAUT extensions such as UTAUT2 incorporate consumer-based variables (hedonic motivation, price value, habit), clinical decisions are typically guided by medical need rather than user enjoyment or cost preferences. For antenatal mothers, context-specific determinants such as self-efficacy (SE) and health literacy (HL) therefore become more relevant, influencing users' ability to interpret information, operate digital platforms and engage meaningfully with VC (Hsieh & Lai 2020; Liu et al. 2022; Mackert et al. 2016; Nisha et al. 2019). Figure 1 presents the study's conceptual framework.

The aim of this study is to develop and pilot-test an instrument to measure antenatal mothers' acceptance of VC services using an extended UTAUT framework that incorporates health HL and SE.

Universal Technology Acceptance Predictors

UTAUT identifies four key determinants of technology acceptance: performance expectancy

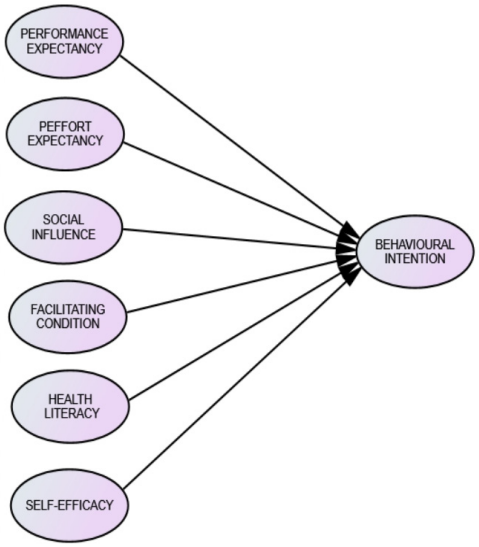

FIGURE 1: Conceptual framework

(PE), effort expectancy (EE), social influence (SI) and facilitating conditions (FC) (Venkatesh et al. 2003). Evidence from MCH studies shows that these constructs significantly influence the use of digital health tools among antenatal mothers (Hasibuan et al. 2022; Namatovu et al. 2021). Accordingly, UTAUT was adopted as the theoretical foundation for assessing acceptance of VCs in antenatal care and its core constructs were adapted for the present study.

(i) Performance expectancy

PE is the degree to which an individual believes that using the system will help him or her to attain gains in job performance (Venkatesh et al. 2003), and is widely recognised as a key determinant of intention to adopt technology. In this study, PE captures antenatal mothers' beliefs that using VC for antenatal care will be beneficial and convenient, supporting pregnancy care by reducing access and geographical barriers and serving as a viable alternative to physical visits. Prior telehealth research similarly identifies PE as an important predictor of usage intention and actual use in healthcare settings making it a crucial element in their decision to use and embrace the technology (Alabdullah et al. 2020; Diño & de Guzman 2015; Napitupulu et al. 2021; Shiferaw et al. 2021; Siripipatthanakul et al. 2023).

(ii) Effort expectancy

EE is the degree of ease associated with the use of the system (Venkatesh et al. 2003). Systematic reviews of telehealth service use consistently identify EE as one of the strongest predictors of technology acceptance in healthcare (Harst et al. 2019; Rouidi et al. 2022). Users are more inclined to adopt and utilise a service when they perceive it as user-friendly and requiring minimal effort to operate, which enhances acceptance intention. In this study, EE reflects users' perceptions of the ease and simplicity of using VC services for antenatal care. This relationship is especially important in maternal healthcare, where digital literacy levels may vary, making ease of use a critical prerequisite for technology adoption. Evidence further indicates that mothers are more likely to integrate VC services into their antenatal routines when the technology is intuitive and easy to use (Hasibuan et al. 2022; Kasaya et al. 2025).

(iii) Social influence

SI is defined as the degree to which an individual perceives that important others believe he or she should use the new system (Venkatesh et al. 2003). It captures how encouragement or expectations from significant others (e.g., family members, peers and social contacts) shape behavioural decisions, particularly in healthcare technology use. In this study, SI reflects the influence of family members, peers and healthcare providers' recommendations on antenatal mothers' decisions to use VC services. Individuals are more likely to adopt technological solutions when they observe others' use or receive encouragement, highlighting the role of social approval and normative pressure in health-related behaviours (Finlay et al. 1999; Ifinedo

2016). Empirically, SI has often been reported as a significant predictor of acceptance of health ICTs (Kaphzan et al. 2022; Rahi et al. 2021; Vidal-Silva et al. 2024), although some studies report weaker or negligible effects (Garavand et al. 2019; Napitupulu et al. 2021). Nevertheless, SI remains theoretically central within UTAUT as a determinant of technology acceptance.

(iv) Facilitating conditions

Facilitating conditions (FC) refers to the degree to which an individual believes that technical and organisational infrastructure exists to support the use of the system (Venkatesh et al. 2003). In UTAUT, FC is conceptualised primarily as a determinant of actual use, while UTAUT2 indicates that FC can also directly influence behavioural intention to adopt new technologies (Venkatesh et al. 2012). In this study, FC reflects the extent to which antenatal mothers perceive that enabling resources for VC are available, including reliable internet connectivity, access to appropriate devices and technical assistance. Prior research similarly identifies internet stability, data affordability, device access, technical support, training opportunities and varying digital literacy as key enabling conditions for telehealth adoption among pregnant women (Brusniak et al. 2020; Namatovu et al. 2021; Rahdar et al. 2023), with stronger digital infrastructure linked to greater user confidence and competence (Rahi et al. 2021). When such conditions are in place, perceived barriers are reduced and VC use becomes more feasible and sustainable, thereby strengthening users' readiness and ability to engage with VC platforms.

(v) Behavioural intention

BI is defined as the strength of one's intention to perform a specified behaviour (Davis 1989) and is widely regarded as an immediate antecedent of individuals' actual technology use (Tarhini et al. 2016; Venkatesh et al. 2003; Venkatesh et al. 2012). In this study, BI reflects antenatal mothers' intention to continue using VC services, based on their prior VC experience and is commonly used as an indicator of technology acceptance (Alajmi & Alotaibi 2020; Hoque et al. 2016; Lutfi 2022). Within antenatal care, BI captures mothers' motivation and readiness to integrate VC into their care routines, shaped by perceived usefulness, ease of use, social influence and access to digital resources. Stronger behavioural intention is generally associated with a higher likelihood of actual use, particularly when users perceive clear value and minimal barriers to engaging with digital health platforms (Khan & Abideen 2023; Marikyan & Papagiannidis 2021).

Context-specific Predictors

(i) Self-efficacy

SE grounded in Social Cognitive Theory (SCT), refers to an individual's confidence in their ability to perform tasks within a specific context (Bandura 1986; Bandura et al. 1999). In technology adoption research, SE is commonly defined as users' belief in their capability to perform technology-related tasks or use information systems effectively (Compeau & Higgins 1995; Yeşilyurt et al. 2016). Evidence consistently shows that individuals with higher SE are more likely to perceive digital health technologies as manageable and user-friendly, leading to greater confidence in using them (Bilgrami et al. 2020; Liu et al. 2022; Shiferaw et al. 2021). Conversely, low SE is associated with perceiving systems as complex and reduced likelihood of engagement (Musa & Deji 2024). In this study, SE reflects antenatal mothers' confidence in their ability to operate VC platforms effectively to support their pregnancy-related health needs.

(ii) Health literacy

HL refers to an individual's ability to obtain, understand, evaluate and apply health information to make informed decisions and manage well-being (Wilson & Lankton 2004; World Health Organisation 2020). It supports navigation of healthcare services, communication

with providers and engagement in health-promoting behaviours, and is widely recognised as a determinant of health behaviour and self-management (Apfel & Tsouros 2013; Hsieh & Lai 2020). In this study, HL reflects antenatal mothers' knowledge and comprehension of maternal health information and their ability to interpret and apply that information in decisions about their care. Higher HL is associated with greater capability and confidence in using digital health technologies and benefiting from virtual platforms (Mackert et al. 2016; Suleiman 2025). In antenatal care, adequate HL may support engagement with VC services, whereas limited maternal health knowledge may increase preference for face-to-face consultations due to concerns about misinterpretation or incorrect decisions. HL has also been linked to acceptance and use of teleconsultation services, as higher literacy strengthens confidence, comprehension and readiness to engage with digital healthcare platforms (Lebrument 2025).

MATERIALS AND METHODS

As part of the early work undertaken for the larger study, this paper reported on the pilot EFA used to develop and refine items for assessing technology acceptance of VC services in antenatal care. A comprehensive literature review guided the adaptation and refinement of items representing technology acceptance constructs, which were evaluated in this pilot study to examine their underlying factor structure and preliminary reliability and validity. The study employed a cross-sectional design using a self-administered online questionnaire accessed via individualised QR codes distributed on printed handouts. Data from the pilot study were analysed using EFA in Statistical Package for the Scial Sciences (SPSS), version 28.0 (IBM Corp., Armonk, NY, USA).

Clinic Selection and Participants

The Ministry of Health, Malaysia (MOHM) 2020 Annual Report noted that the public healthcare system comprised 1,131 health clinics, 1,656 rural clinics, 77 MCH clinics and 205 community clinics (KKom) (Ministry of Health Malaysia Annual Report 2024). VC services were first piloted in 2019 and later expanded following encouraging feedback. In 2022, the MOH further extended VC services to include MCH care (Bahagian Pembangunan Kesihatan Keluarga, Kementerian Kesihatan Malaysia 2022). As part of the MOH's virtual healthcare initiative, 40 clinics across several states were selected to implement VC services, predominantly in urban areas where digital infrastructure and staffing capacity were sufficiently established to support such services. However, integration of VC specifically into antenatal care remained limited during the study period. Only 11 clinics offered VC services for MCH, while most participating clinics utilised VC mainly for non-communicable disease (NCD) management, respiratory care and allied health consultations. Accordingly, the sampling frame for this study was concentrated in early-adopter urban clinics, and rural or low-resource clinics were not represented during data collection. The 11 MCH clinics included in this study functioned as early adopters of digital healthcare for maternal services, providing an appropriate context for examining VC acceptance in antenatal care.

A total of 103 antenatal mothers with prior experience using VC services for antenatal care were recruited using purposive sampling from the 11 designated clinics. This sample size met commonly cited minimum guidance for early-stage exploratory analysis in pilot EFA studies, thereby supporting the adequacy of the data for preliminary analysis (Awang 2012; Awang 2015; Awang et al. 2023; Dehisat & Awang 2020; Ehido et al. 2020; Hair et al. 2019). In addition, Kaiser–Meyer–Olkin (KMO) exceeded 0.60, and Bartlett's Test of Sphericity was significant ($p < 0.05$), further supporting the adequacy of the data for exploratory analysis. The sampling approach was appropriate because only mothers who had previously used VC services could meaningfully evaluate the instrument. In this pilot, the instrument assessed acceptance among VC users rather than adoption among non-users. Restricting participation to VC-experienced

antenatal mothers ensured that responses were grounded in actual service use rather than hypothetical perceptions, although this may limit generalisability to non-users. A filtering question was embedded at the start of the Google Forms (Google LLC, Mountain View, California, USA) survey to confirm eligibility ("Have you previously used VC services for antenatal care?" Yes/No). Only respondents who indicated prior VC use were allowed to proceed to the main section of the survey; those without such experience were prevented from continuing. This ensured that all participants met the inclusion criteria and that responses reflected relevant user experience. To maintain the integrity and representativeness of the primary research, participants in the pilot phase were excluded from the main study sample.

Respondents were given access to the survey between July and August 2023. The questionnaire was administered digitally via Google Forms, and participants received individualised QR codes printed on paper-based handouts distributed by the clinic's MCH nurses during routine antenatal visits. Each handout included a brief introduction outlining the study's purpose and scope. Upon scanning the QR code, respondents were directed to an online information sheet describing the study and providing instructions for completing the survey. Participants were informed that their participation was voluntary and that all responses would remain confidential and anonymous; no identifiable information, such as names or contact details, was collected.

All items were set to mandatory, and survey submission was permitted only once all required questions had been completed. This procedure minimised item-level missing data and ensured that only complete and eligible responses were recorded. Participants could withdraw at any point before final submission, in which case the system automatically discarded incomplete entries. This approach strengthened data integrity, safeguarded respondent confidentiality, and enabled efficient digital data collection while reducing paper use.

Ethics Approval

This research was approved by the Institutional Review Board of the Ministry of Health Medical Research & Ethics Committee (NMRR ID-23-00611-9XO (IIR)) and the Research and Ethics Secretariat, Univeristi Kebangsaan Malaysia (UKM PPI/111/8/JEP-20230121). Informed consent was obtained from all participants prior to their involvement in the study. Consent was integrated into the Google Form survey, where participants were required to provide explicit agreement before proceeding. Those who did not consent were automatically excluded, ensuring voluntary participation. All methods adhered to relevant guidelines and regulations.

Instrument

Existing validated instruments were adapted for this study, with several items revised to align with the antenatal care and VC contexts. An extensive literature review was conducted to identify relevant constructs and support the development of appropriate measurement items. Consistent with methodological recommendations (Bahkia et al. 2019; Bahkia et al. 2020; Hoque et al. 2018; Rahlin et al. 2019; Shkeer & Awang 2019), modified instruments required rigorous validation, particularly when the original tools were designed for populations with different cultural or clinical backgrounds. Accordingly, pre-testing and pilot testing were performed, followed by EFA to reassess item suitability in this new setting, as some items may no longer be relevant or perform adequately (Awang 2012; Boateng et al. 2018; Muda et al. 2020; Noor et al. 2015).

Building on this process, the measurement items for this study were then developed and adapted from the technology acceptance framework proposed by Venkatesh et al. (2003) and Venkatesh et al. (2012). A total of 36 items, primarily drawn from the original UTAUT scale, were revised and operationalised to suit the antenatal VC context, with additional items incorporated to capture constructs relevant

to maternal healthcare. Following adaptation, the instrument underwent pre-testing and a subsequent pilot study to ensure clarity, cultural appropriateness and conceptual alignment. The refined items were then subjected to EFA to confirm their factorability, validity and reliability within the new population and setting.

The key constructs of the UTAUT framework included PE (five items), EE (four items), SI (five items), FC (eight items) and BI (four items). The framework was extended by incorporating two additional context-specific constructs, HL and SE, which had been shown to be relevant predictors in digital health adoption (Hsieh & Lai 2020; Nisha et al. 2019; Shiferaw et al. 2021; Rahi et al. 2021). Five items from prior studies (Kayser et al. 2018; Nisha et al. 2019) were adapted to measure HL, while five SE items were adopted and refined based on earlier healthcare research (Lufti 2022; Rahi et al. 2021). Both HL and SE were included due to their importance in shaping health-related actions, digital health engagement and sustained behaviour change by equipping individuals with the knowledge and confidence needed for effective health management, thereby supporting their inclusion as key constructs in the adapted UTAUT model. All items were measured using a five-point interval scale ranging from 1 (strongly disagree) to 5 (strongly agree). Demographic characteristics, including age, monthly income and education level were collected using nominal-scale responses, along with information on participants' VC usage patterns and methods of internet access

Validation

The researcher followed previously suggested forward and backward translation procedure guidelines (Daud et al. 2022; Sousa & Rojjanasrirat 2011) and collaborated with a certified translator. To ensure the appropriateness of the translated terms, the survey was made available to the expert panel reviewers in both Malay and English, allowing them to evaluate the translated items against the original English survey. The four translators (two translating forward and two translating backwards) enabled the cross-validation and detection of translation discrepancies or inconsistencies. Employing multiple translators in academic or research settings can enhance research credibility and validity (Sousa & Rojjanasrirat 2011).

Pre-testing is an essential step in survey-based research (Hashim et al. 2022; Ikart 2019). Expert input was first obtained to establish content and criterion validity, followed by pre-testing with the target population to evaluate face validity. The pre-test process is intended to identify and rectify any issues related to item clarity, structure or design before full-scale data collection (Babin et al. 2020). Five experts, including representatives from the Family Health Development Division, Ministry of Health, Public Health Specialists, Family Medicine Specialists, and Obstetrics and Gynaecology Specialists, were recruited to establish content and criterion validity. These experts were selected based on their qualifications, senior clinical or policy roles within the Ministry of Health, and extensive experience in MCH services and VC implementation, ensuring their relevance and suitability as content validators. Fernández-Gómez et al. (2020) noted that content validation through expert judgment requires input from individuals with substantial expertise in the relevant field.

The content validity of the instrument was assessed using the Content Validity Index (CVI). The first version of the instrument was emailed to the expert panel to evaluate the relevance of items within the technology acceptance domains. The experts' contributions involved elucidating, clarifying, augmenting and refining the items, consistent with Zun et al. (2019), to ensure that the instrument was conceptually sound and easily understood by its intended population. Following content validation, face validity was conducted to assess the clarity and comprehensibility of the instructions and item wording. This process employed the Face Validity Index (FVI) (Yusoff 2019a) and involved 15 pregnant women who were current users of VC services. The researcher personally distributed the second version of the instrument and the face validation form during

clinic visits. The clarity of each item was rated by respondents on a 4-point scale: 1 = not clear, 2 = somewhat clear, 3 = quite clear and 4 = highly clear (Yusoff 2019b). Additionally, respondents could approach the researcher or provide written comments on items they found challenging to comprehend or that required modification.

The CVI and FVI were computed adhering to the proposed guidelines and parameters (Polit et al. 2007; Yusoff 2019a; Yusoff 2019b). A widely accepted threshold for the Item Content Validity Index (I-CVI) is 0.79, while the Scale Content Validity Index (S-CVI) should average 0.80 to indicate acceptable content validity (Polit et al. 2007). Similarly, face validity was assessed at both the item and scale levels, with an Item Face Validity Index (I-FVI) of 0.79 and a Scale Face Validity Index (S-FVI) of 0.80 considered acceptable (Yusoff 2019a; Yusoff 2019b).

The results showed a Scale-CVI average (ICVI-A) of 0.983 and a universal agreement index (CVI-UA) of 0.916. Face validity values were also within acceptable ranges, with an FVI average of 0.988 and a universal agreement score (FVI-UA) of 0.833. Two items from the HL construct were removed because their I-CVI values fell below the 0.80 threshold, and several other items were revised in response to expert feedback to improve clarity and relevance. Any disagreements or suggestions raised by the experts were addressed through follow-up email discussions until consensus was reached on the final set of items. The instrument was then refined accordingly and prepared for field administration. A pilot study was subsequently conducted as a small-scale preliminary test to assess the feasibility of the survey procedures and identify any potential issues before full-scale implementation (Porta

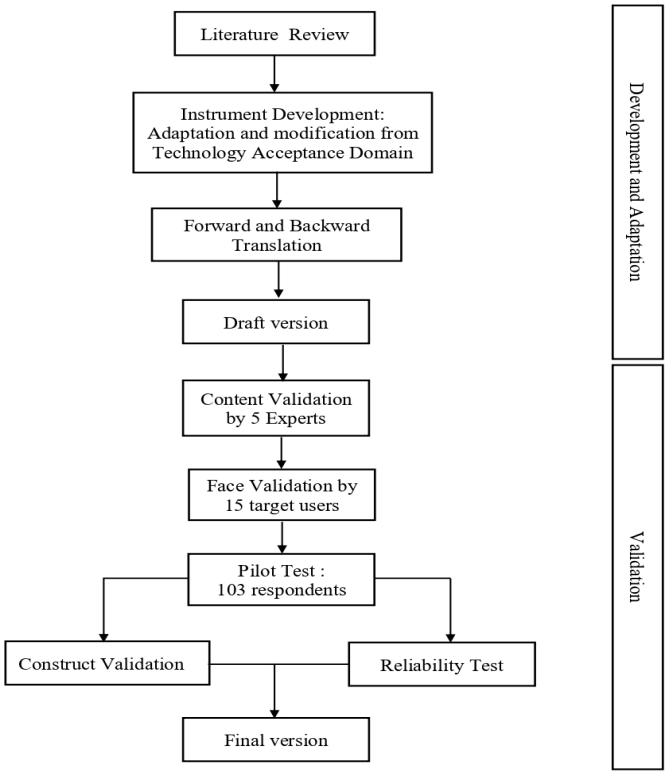

FIGURE 2: Development and validation process of the instrument

2008; Dźwigoł 2020). Data from the pilot phase were analysed using EFA, providing preliminary evidence on the measurement structure and internal consistency of the items and informing further refinement where necessary. Figure 2 illustrated the instrument development process, detailing the sequential steps from initial design to the pilot screening stage, including construct-level dimensionality assessment via EFA and reliability analysis to support measurement consistency.

Exploratory Factor Analysis Procedure

EFA is a statistical technique used to explore the underlying structure (dimensionality) of a set of observed variables and to determine how items cluster within a dataset (Musa et al. 2023; Sürücü et al. 2022). As part of the EFA procedure, data suitability is assessed by evaluating sampling adequacy and factorability using the KMO measure and Bartlett's Test of Sphericity (BTS). KMO values above 0.60 and a statistically significant BTS result ($p < 0.05$) indicated that the correlation matrix was sufficiently factorable for exploratory analysis (Al-Khamaiseh et al. 2019; Alias et al. 2019; Awang 2012; Hair et al. 2019). In exploratory extraction, the total variance explained was typically examined to ensure that the retained solution accounts for a meaningful proportion of variance (a 50–60%), and items were retained when they exhibited substantial loadings (≥ 0.60) with minimal cross-loadings (Rahlin et al. 2019; Muda et al 2020).

For this study, principal component analysis (PCA) was applied in the exploratory phase as a preliminary dimensionality screening and item-reduction procedure because the instrument was administered to a new population and setting. All exploratory procedures (assumption checks, component retention, rotation and item retention decisions) were conducted separately within each construct block. Specifically, PCA was performed separately for each theoretical construct (e.g., PE, EE, SI, FC) to examine whether each construct was empirically unidimensional or comprised multiple components in this context and to inform item refinement (Shkeer & Awang 2019). PCA is commonly applied in early-stage instrument refinement to identify preliminary item groupings (components) and to reduce items based on the pattern of inter-item correlations observed in the target population (Sürücü et al. 2022). Varimax rotation was applied to improve interpretability by maximising the variance of component loadings across items (Hair et al. 2019). Component retention was guided by eigenvalues (> 1.0) and inspection of the scree plot. Items were retained when they demonstrated strong component loadings (≥ 0.60) on the intended component and minimal cross-loadings, while weak or cross-loading items were removed. The refined item sets were then evaluated using CFA to establish the latent measurement model prior to Structural Equation Modelling (SEM).

The analysis adhered to established psychometric acceptability thresholds, including a KMO value exceeding 0.6, a significant Bartlett's Test of Sphericity ($p < 0.05$), total variance explained (TVE) above 60%, and factor loadings greater than 0.60 for item retention (Ehido et al. 2020). Table 1 summarised the EFA procedures, statistical thresholds and methodological decisions applied for factor extraction, rotation and item retention.

As this pilot EFA focused on preliminary dimensionality assessment, item–total correlations and 'alpha if item deleted' diagnostics will be examined during the CFA phase of the main study. Any further item reduction, including evaluation of potential item redundancy will likewise be guided by the CFA measurement model results in the full validation process.

RESULTS

EFA was conducted in accordance with established procedures outlined by Bahkia et al. (2019), Rahlin et al. (2019), Shkeer and Awang (2019) and Yahaya et al. (2018). EFA was performed for each variable to detect potential changes in item dimensionality relative to previous studies, which may occur due to differences in population characteristics. The

TABLE 1: Steps for exploratory factor analysis and statistical thresholds

EFA Procedures	Methodological guidelines
Evaluation of Data Factorability	Correlation Matrix > 0.3 KMO > 0.6 Bartlett's Test of Sphericity > 0.05
Factor Extraction Method	Principal Component Analysis
Selection of Rotational Method	Varimax rotation
Factor Retention Method	Total Variance Explained > 60% Kaiser Eigenvalue > 1 Scree Plot Parallel Analysis
Interpretation & Labelling of Constructs	Retain label if meaningful & consistent with literature. Create new labels for new constructs

EFA: Exploratory Factor Analysis; KMO: Kaiser–Meyer–Olkin

study adapted instruments from prior research, making necessary adjustments to certain items to suit the current context. Using pilot data, EFA was employed to assess the dimensionality and relevance of each item within its construct. The analysis included calculating mean scores, standard deviations, factor loadings and total variance explained for each construct. Additionally, Cronbach's alpha was computed to evaluate internal consistency (Rahlin et al. 2019; Baistaman et al. 2020). Following the removal of two items during the content validation stage, EFA was conducted on the remaining items, and no additional items were removed based on the statistical thresholds outlined in Table 1. A summary of item retention across the CVI, FVI and EFA stages by construct is presented in Table 2. The retained constructs, items and sources were provided in the Supplementary Materials.

TABLE 2: Item retention summary during instrument development (CVI, FVI and EFA stages)

Construct	Initial number of items	Items retained after CVI		Items retained after FVI		Items retained after EFA FL> 0.6
		S-CVI Ave = 0.983	S-CVI UA = 0.916	S-FVI Ave = 0.988	S-FVI UA = 0.833	
Performance Expectancy	5	5		5		5
Effort Expectancy	4	4		4		4
Social Influence	5	5		5		5
Facilitating Condition	8	8		8		8
Behavioural Intention	4	4		4		4
Self-Efficacy	5	5		5		5
Health Literacy	7	5		5		5
Total	38	36		36		36

CVI: Content validity index; FL: Factor loading; FVI: Face validity index; EFA: Exploratory factor analysis: S-CVI Ave: Average scale-level content validity index; S-CVI UA: Universal agreement scale-level CVI; S-FVI Ave: Average scale-level face validity index; S-FVI UA: Universal agreement scale-level FVI

Exploratory Factor Analysis Procedure for Unified Theory of Acceptance and Use of Technology Model Constructs

The constructs were measured by adapting items from the UTAUT model (Venkatesh et al. 2003, 2012). The constructs were PE, EE, FC, SI and BI. Table 3 displayed the mean response, standard deviation and item statement for every item of each construct. The mean score and standard deviation of each item demonstrated a consistent score distribution with the standard deviation for each item being less than 1.0.

The EFA used PCA for these items to examine the constructs adapted from the UTAUT model. Table 3 demonstrated that the BTS results were

TABLE 3: Mean and standard deviation for every item

Construct	Items	Summary of item statement	Mean	Std. Deviation
Performance Expectancy	PE1	I find Virtual or online consultation services (via Google Meet/Zoom/ video call) useful in managing my pregnancy care	3.98	0.885
	PE2	Virtual consultation service allows me to obtain routine pregnancy care appointments more quickly and conveniently	4.09	0.898
	PE3	Using virtual consultation services makes my life easier and increases daily productivity	3.98	0.950
	PE4	I can obtain pregnancy health care easily with the use of virtual consultation service	3.94	0.998
	PE5	The use of virtual consultation services would ease my pregnancy care	3.90	0.995
Effort Expectancy	EE1	Learning how to operate virtual consultation services is easy for me	3.92	0.957
	EE2	Communication and interaction through virtual consultation services for pregnancy care are clear and easy to understand	3.85	0.923
	EE3	I find virtual consultation service systems to be user-friendly and easy to use	3.85	0.994
	EE4	It would be easy for me to become skilful at using virtual consultation services	3.92	0.893
Social Influence	SI1	People who are important to me think that I should use virtual consultation services for my pregnancy care	3.74	0.949
	SI2	People who influence my behaviour think I should use virtual consultation service for my pregnancy care	3.69	0.960
	SI3	People whose opinions I value prefer I use virtual consultation service for my pregnancy care	3.71	0.966
	SI4	If the virtual consultation service has become a trend among people around me, I would consider using it	3.94	0.906
	SI5	If health personnel prefer to use virtual consultation services for pregnancy care, I am willing to use it	3.96	0.939
Facilitating Condition	FC1	I have the necessary resources to use the virtual consultation service	4.04	0.969

Continued...

...continuing

Construct	Items	Summary of item statement	Mean	Std. Deviation
	FC2	I have the knowledge necessary to use virtual consultation services	3.95	0.994
	FC3	Virtual consultation service is compatible with digital technologies I use	3.97	0.934
	FC4	I can get help from others when I have technical difficulties while using virtual consultation service	3.90	0.995
	FC5	It is easy to get technical support and advice from healthcare personnel related to virtual consultation service use	3.88	0.911
	FC6	Health personnel give clear instructions and guidance if I have any problems with my pregnancy care through virtual consultation service	3.91	0.909
	FC7	There is a system manual (specialized instruction on hardware and software) concerning virtual consultation service available to the user	3.79	0.925
	FC8	Detailed explanations or training are given to facilitate the utilisation of VC service	3.86	0.950
Behavioural Intention	BI1	I intend to use virtual consultation service in the future	3.84	0.988
	BI2	I will continue to use virtual consultation service for my pregnancy care	3.85	0.933
	BI3	I plan to use virtual consultation service frequently for my pregnancy care	3.88	0.889
	BI4	Given that I have access choice to use VC service, I would use the services	3.87	0.915
Self-Efficacy	SE1	I am confident in my ability to use the virtual consultation service for pregnancy care	3.96	0.979
	SE2	I am competent with the operation of virtual consultation service systems	3.85	1.004
	SE3	I am proficient at using virtual consultation services for health care	3.85	1.004
	SE4	I can handle most technical issues related to virtual consultation services without assistance	3.84	0.988
	SE5	I can understand and manage most of the health advice related to pregnancy care given by medical personnel through virtual consultation services	3.89	0.989
Health Literacy	HL1	I have sufficient knowledge to understand and address my pregnancy issues	3.79	0.987
	HL2	Medical guidance provided through virtual consultation service is sufficient for understanding my health condition	3.79	0.977
	HL3	I have sufficient health knowledge to confidently utilise virtual consultation services for my pregnancy care	3.79	0.946
	HL4	I am aware of the warning signs and symptoms related to pregnancy concerns	3.84	0.926
	HL5	I often use digital technology to understand and search for health information	3.98	0.918

significant ($p < 0.05$). In addition, the KMO value exceeded the minimum threshold of 0.60 (Awang 2012), confirming sampling adequacy, consistent with guidance from prior EFA methodological studies (Alias et al. 2019; Al-Khamaiseh et al. 2019; Shkeer & Awang 2019). The combined evidence from the significant BTS and the KMO measure > 0.6 strongly supported the suitability and adequacy of the dataset for factor analysis.

The scree plot for all items corresponding to their respective constructs revealed the emergence of a single distinct component for each construct from the EFA. This finding was consistent with eigenvalues exceeding the threshold of 1, thereby supporting the unidimensionality of the constructs. Furthermore, the TVE for these constructs exceeded 60%, indicating that a substantial proportion of the variance was captured by the single component, as presented in Table 4. Consequently, the TVE values were deemed acceptable, as they surpassed the commonly recognised threshold of 60% (Noor et al. 2015; Bahkia et al. 2019; Baistaman et al. 2020; Ehido et al. 2020).

Table 5 presented the components and dimensions for each item, showing that all items belong to a single component of their respective constructs. According to Awang (2015), Yahaya et al. (2018) and Ehido et al. (2020), the minimum acceptable factor loading for individual items should be greater than 0.6 to ensure retention. Consequently, all items were retained.

EFA Procedure for Self-Efficacy

The SE construct was measured using five items (SE1–SE5), as detailed in Table 3**,** which also presented the mean response, standard deviation and item statement for each item. The mean scores and standard deviations for each item demonstrated a consistent score distribution, with standard deviation for each item was < 1.5. EFA was conducted using the PCA extraction method with varimax (variation maximisation) rotation for the five items to assess the SE construct. Table 6 showed that the BTS was significant ($p < 0.05$), and the KMO measure of sampling adequacy was 0.918, surpassing the lower threshold of 0.6. This result indicated that the sample size was adequate, as indicated by Rahlin et al. (2019)

TABLE 4: Total variance explained contributed by individual components of each construct

Construct	Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
		Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Performance Expectancy	1	4.257	85.140	85.140	4.257	85.140	85.140
Effort Expectancy	1	3.683	92.085	92.085	3.683	92.085	92.085
Social Influence	1	4.365	87.309	87.309	4.365	87.309	87.309
Facilitating Condition	1	6.513	81.415	81.415	6.513	81.415	81.415
Behavioural Intention	1	3.686	92.140	92.140	3.686	92.140	92.140
Self-Efficacy	1	4.731	94.629	94.629	4.731	94.629	94.629
Health Literacy	1	4.479	89.582	89.582	4.479	89.582	89.582

Extraction method: Principal component analysis

TABLE 5: The factor loading for each item and its component

Construct	Items	Component 1 (Factor loading)
Performance Expectancy	PE1	0.909
	PE2	0.934
	PE3	0.932
	PE4	0.913
	PE5	0.925
Effort Expectancy	EE1	0.958
	EE2	0.962
	EE3	0.971
	EE4	0.947
Social Influence	SI1	0.946
	SI2	0.914
	SI3	0.976
	SI4	0.925
	SI5	0.910
Facilitating Condition	FC1	0.908
	FC2	0.901
	FC3	0.925
	FC4	0.895
	FC5	0.950
	FC6	0.920
	FC7	0.856
	FC8	0.861
Behavioural Intention	BI1	0.960
	B12	0.945
	BI3	0.953
	BI4	0.981
Self-efficacy	SE1	0.972
	SE2	0.985
	SE3	0.987
	SE4	0.965
	SE5	0.955
Health Literacy	HL1	0.946
	HL2	0.966
	HL3	0.970
	HL4	0.919
	HL5	0.930

Extraction method: Principal component analysis.
(1 component extracted)

and Shkeer and Awang (2019). The significant BTS result and KMO above 0.6 confirmed the adequacy of the dataset. The scree plot revealed the emergence of a single distinct component from the EFA, identifying the respective items within this component (Baistaman et al. 2020; Yahaya et al. 2018). The TVE for the SE construct was 94.629%, as shown in Table 4, well above the minimum acceptable threshold of 60% (Hoque et al. 2016; Hoque et al. 2018; Yahaya et al. 2018; Rahlin et al. 2019). Table 5 presented the components and dimensions of individual items for SE, indicating that all items were grouped under a single component. To ensure retention, each item's loading factor should be >0.6, as recommended by Mohamad et al. (2018) and Yahaya et al. (2018). Consequently, all items met this criterion and were retained.

TABLE 6: The value for KMO and Bartlett's test

	Kaiser-Meyer-Olkin Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
		Approx. Chi-Square	df	Sig.
Performance Expectancy	0.878	557.614	10	p < 0.001
Effort Expectancy	0.881	553.018	6	p < 0.001
Social Influence	0.841	711.503	10	p < 0.001
Facilitating Condition	0.902	1258.872	28	p < 0.001
Behavioural Intention	0.850	581.153	6	p < 0.001
Self-Efficacy	0.918	995.334	10	p < 0.001
Health Literacy	0.920	700.139	10	p < 0.001

df: Degree of freedom; Sig: Significance

Exploratory Factor Analysis Procedure for Health Literacy

The HL construct was assessed using five items (HL1–HL5), as shown in Table 3. The table reported the mean scores, standard deviations and corresponding item statements. The standard deviation for all items was <1, indicating a stable and consistent response pattern across participants. The EFA used PCA to extract the five items that measured the HL construct. Table 6 reported a significant result for the BTS, with $p < 0.05$. Furthermore, the KMO measure of sampling adequacy yielded a value of 0.920, exceeding the 0.6 minimum threshold and thus suggesting the adequacy of the sample size (Yahaya et al. 2018). The significant BTS and KMO values exceeding 0.6 underscored the dataset's adequacy for analysis. The scree plot for the HL construct revealed that only a single component emerged from the EFA. As noted in Table 5, all items had factor loadings above 0.6, meeting the recommended criterion for item retention. The TVE for this construct was 89.58%, as shown in Table 4, which was acceptable as it surpassed the minimum threshold of 60% (Hoque et al. 2018; Musa et al. 2023; Yahaya et al. 2018).

The Internal Reliability of the Measuring Instrument

Internal consistency reliability was assessed using Cronbach's alpha using SPSS, which was appropriate for reflective constructs in early-stage instrument development. This analysis evaluated the degree to which items within a construct measure the same underlying concept. Following Awang (2012), Awang (2015) and Hair et al. (2019), a threshold of 0.70 was adopted as the minimum acceptable value for Cronbach's alpha. Constructs with alpha values above this threshold were considered reliable. All constructs met this criterion, as shown in Table 7, indicating satisfactory internal consistency. It was important to note that Cronbach's alpha assessed internal consistency only and did not provide evidence of construct validity. Several constructs recorded alpha values greater than 0.90, indicating very strong internal consistency, but also signalling the possibility of item redundancy. Such values were not uncommon in short, reflective scales with closely related items; therefore, alpha > 0.90 was interpreted cautiously and potential redundancy will be evaluated using item-level diagnostics and the confirmatory measurement model in the main study.

DISCUSSION

The pilot EFA demonstrated a clear and coherent factor structure across all constructs, indicating that the adapted instrument performs satisfactorily at the initial measurement stage for assessing antenatal mothers' acceptance of VC services in Malaysian public healthcare. The factor structure obtained aligns with the conceptual domains of the extended UTAUT framework and is consistent with prior UTAUT-based healthcare instrument

TABLE 7: The internal reliability value for each construct

Construct	Number of items	Cronbach's alpha
Performance Expectancy (PE)	5	0.956
Effort Expectancy (EE)	4	0.971
Social Influence (SI)	5	0.963
Facilitating Condition (FC)	8	0.967
Behavioural Intention (BI)	4	0.971
Self-efficacy (SE)	5	0.986
Health Literacy (HL)	5	0.971

studies, which commonly report coherent item clustering and stable construct patterns during early instrument testing (Hsieh et al. 2017; Shiferaw et al. 2021; Lutfi 2022). Notably, much of the UTAUT literature in healthcare has prioritised testing structural relationships among constructs, while measurement-focused instrument-development evidence remains comparatively limited in healthcare settings overall and especially in maternal healthcare contexts. In particular, the present pilot reflects the expected UTAUT-domain structure in a maternal digital health context, suggesting that the adapted items functioned as intended within this service setting. All constructs exhibited high factor loadings (>0.60), reflecting strong associations between items and their underlying latent constructs. In UTAUT-based studies, such loading patterns are expected because the constructs are theoretically well-established, reflectively modelled and conceptually homogeneous. In this study, the consistently high loadings are interpreted as evidence of clear item–construct alignment rather than redundancy, particularly because the items were adapted from validated UTAUT instruments and underwent expert content and face validation before data collection (DeVellis 2017; Lambert & Newman 2023).

Construct reliability was also high, with Cronbach's alpha values ranging from 0.956 to 0.986, exceeding the conventional threshold of 0.70. The notably high alpha for SE ($\alpha = 0.986$) may indicate possible overlap among items; however, given the reflective nature of the construct and its theoretical grounding in digital health research, these values are likely reflective of strong internal coherence within this population. These observations will be examined more rigorously during CFA, where item redundancy, composite reliability and discriminant validity will be assessed (DeVellis 2017).

High TVE was also observed for certain constructs, particularly SE (94.63%) and HL (89.58%). These results indicate strong unidimensionality and item homogeneity, which are typical when constructs are narrowly defined and when items closely reflect a single latent domain. The use of PCA, which models total rather than common variance, contributes to elevated TVE values. Pilot samples also tend to be more homogeneous, reducing measurement noise and increasing communalities, thereby inflating factor saturation. As such, the high TVE values are interpreted as supportive but provisional indicators of measurement coherence, pending validation with a larger and more diverse sample using common-factor methods during CFA.

Overall, the pilot results demonstrate that the adapted items are functioning as intended and that the emerging measurement structure is sufficiently stable to proceed to the confirmatory stage. These findings align with prior UTAUT-based healthcare studies, which commonly report strong factor loadings, high internal consistency, and well-defined factor solutions during initial testing. In this respect, the study contributes to the evidence base by developing and preliminarily evaluating a VC acceptance instrument adapted specifically for antenatal care in Malaysia, addressing a contextual gap where generic technology-acceptance or telehealth instruments may not fully capture the service characteristics and user needs associated with maternal healthcare. However, because

EFA provides only preliminary measurement evidence, the results should not be interpreted as conclusive. The next phase of the study will involve CFA to assess model fit, refine the item structure, evaluate convergent and discriminant validity, and examine construct stability across larger and more heterogeneous samples. SEM will subsequently be employed to test theoretical relationships within the extended UTAUT framework once the measurement model has been validated.

This pilot study has several limitations. The pilot sample size (n = 103) may limit the stability and generalisability of the exploratory component structure; therefore, the factor structure should be confirmed using CFA in a larger, independent sample. The study sites were early-adopter urban clinics in which VC services had already implemented and supported by relatively robust digital infrastructure and staffing capacity, which may limit generalisability to rural or low-resource settings (including private healthcare settings) where infrastructure, access, digital literacy and workforce capacity differ. The sample comprised solely of antenatal mothers with VC experience, limiting insight into perceptions and barriers among non-users and potentially overestimating acceptability relative to the broader antenatal population. PCA was used at this pilot stage for preliminary dimensionality screening and item reduction; subsequent validation should incorporate common-factor methods (e.g., Principal Axis Factoring) and full psychometric evaluation. Finally, as the instrument was developed within the Malaysian sociocultural and healthcare context, cross-context generalisability cannot yet be assumed. Collectively, these limitations reinforce the need for further psychometric testing in the main study, including CFA and measurement invariance testing, and replication in rural and lower-resource clinics as VC implementation expands.

CONCLUSION

This study presents a preliminary evaluation of an adapted instrument designed to assess antenatal mothers' acceptance of VC services in Malaysia. By integrating health literacy and self-efficacy into an extended UTAUT framework, the instrument reflects contextual factors relevant to digital engagement in maternal healthcare. The pilot EFA demonstrated a clear factor structure and satisfactory psychometric properties, indicating that the adapted items performed coherently in this early testing phase.

Given the exploratory nature of this analysis, the findings should be interpreted as initial evidence of construct clarity rather than full validation. Further assessment through CFA and SEM is required to confirm the measurement model, examine validity and establish generalisability, particularly beyond the urban clinics involved in this pilot. Future work should validate the instrument in larger multi-site samples and test measurement invariance across key subgroups before broader application

Overall, the results provide a sound foundation for subsequent validation work and future research on digital health acceptance in maternal healthcare. With additional empirical testing, the instrument can support VC service planning and policy by enabling systematic needs assessment and identifying acceptance barriers and facilitators to guide targeted implementation strategies in Malaysian antenatal care.

Data Availability: This manuscript includes all relevant data generated and analysed during the study. The questionnaire has been deposited in the Open Science Framework (OSF) and is publicly accessible at the following link https://doi.org/10.17605/OSF.IO/UPJER.

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TABLE S1: Measurement constructs, item statements and references

Construct	Items	Summary of items statement	References
Performance Expectancy	PE1	I find Virtual or online consultation services (via Google Meet/Zoom/ video call) useful in managing my pregnancy care	Venkatesh et al. (2003); Venkatesh et al. (2012)
	PE2	Virtual consultation service allows me to obtain routine pregnancy care appointments more quickly and conveniently	
	PE3	Using virtual consultation services makes my life easier and increases daily productivity	
	PE4	I can obtain pregnancy health care easily with the use of virtual consultation service	
	PE5	The use of virtual consultation services would ease my pregnancy care	
Effort Expectancy	EE1	Learning how to operate virtual consultation services is easy for me	Venkatesh et al. (2003); Venkatesh et al. (2012)
	EE2	Communication and interaction through virtual consultation services for pregnancy care are clear and easy to understand	
	EE3	I find virtual consultation service systems to be user-friendly and easy to use	
	EE4	It would be easy for me to become skilful at using virtual consultation services	
Social Influence	SI1	People who are important to me think that I should use virtual consultation services for my pregnancy care	Kijsanayotin et al. (2009); Venkatesh et al. (2003); Venkatesh et al. (2012)
	SI2	People who influence my behaviour think I should use virtual consultation service for my pregnancy care	
	SI3	People whose opinions I value prefer I use virtual consultation service for my pregnancy care	
	SI4	If the virtual consultation service has become a trend among people around me, I would consider using it	
	SI5	If health personnel prefer to use virtual consultation services for pregnancy care, I am willing to use it	
Facilitating Condition	FC1	I have the necessary resources to use the virtual consultation service	Venkatesh et al. (2003); Venkatesh et al. (2012); Ryu et al. (2009); Maarop & Khin, (2011)
	FC2	I have the knowledge necessary to use virtual consultation services	
	FC3	Virtual consultation service is compatible with digital technologies I use	
	FC4	I can get help from others when I have technical difficulties while using virtual consultation service	
	FC5	It is easy to get technical support and advice from healthcare personnel related to virtual consultation service use	
	FC6	Health personnel give clear instructions and guidance if I have any problems with my pregnancy care through virtual consultation service	

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Construct	Items	Summary of items statement	References
	FC7	There is a system manual (specialized instruction on hardware and software) concerning virtual consultation service available to the user	
	FC8	Detailed explanations or training are given to facilitate the utilisation of VC service	
Behavioural Intention	BI1	I intend to use virtual consultation service in the future	Venkatesh et al. (2003); Venkatesh et al. (2012)
	BI2	I will continue to use virtual consultation service for my pregnancy care	
	BI3	I plan to use virtual consultation service frequently for my pregnancy care	
	BI4	Given that I have access choice to use VC service, I would use the services	
Self-Efficacy	SE1	I am confident in my ability to use the virtual consultation service for pregnancy care	Liu et al. (2022); Zha et al. (2022); Shiferaw et al. (2021); Hsieh et al. (2017); Lutfi (2022); Kohnke et al. (2014)
	SE2	I am competent with the operation of virtual consultation service systems	
	SE3	I am proficient at using virtual consultation services for health care	
	SE4	I can handle most technical issues related to virtual consultation services without assistance	
	SE5	I can understand and manage most of the health advice related to pregnancy care given by medical personnel through virtual consultation services	
Health Literacy	HL1	I have sufficient knowledge to understand and address my pregnancy issues	Nisha et al. (2016); Nisha et al. (2019); Wilson & Lankton (2004); Kayser et al. (2018)
	HL2	Medical guidance provided through virtual consultation service is sufficient for understanding my health condition	
	HL3	I have sufficient health knowledge to confidently utilise virtual consultation services for my pregnancy care	
	HL4	I am aware of the warning signs and symptoms related to pregnancy concerns	
	HL5	I often use digital technology to understand and search for health information	