

All-domain complexity of video remote interpreting in maternity care

A NASSS analysis

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Inadequate interpreting services contribute to maternal health disparities among women who require support. Video remote interpreting (VRI) has been promoted as a solution, yet its implementation and sustained uptake remain uneven and poorly understood. This study draws on the non-adoption, abandonment, scale-up, spread and sustainability (NASSS) framework to examine the challenges shaping VRI use in the UK National Health Service's (NHS) maternity care. It analyses a dataset involving women requiring interpreting support and their families, support workers, maternity care professionals, interpreters, bilingual health advocates, language service providers, trainers and a commissioner. The data sources included interviews, surveys, ethnographic observations, a focus group and documentary materials. The qualitative data were analysed using reflexive thematic analysis and were integrated with descriptive statistics across NASSS domains. The analysis shows that the adoption of VRI is shaped by interrelated challenges spanning the NASSS domains, including unpredictable demand, technological constraints, contested value propositions, adopter training challenges and organisational, regulatory and workforce factors. The findings suggest that linguistic diversity functions as a complexity multiplier which amplifies and interconnects implementation challenges across domains, while the effectiveness of VRI depends on the sustainability and governance of the interpreter workforce. These findings highlight the need for ecosystem-level coordination that includes the linguistic, organisational, workforce and technological dimensions of interpreting-assisted maternity care.

Keywords: video remote interpreting, maternity care, NASSS framework, all-domain complexity, healthcare interpreting

1. Introduction

Inadequate spoken-language interpreting services continue to pose serious risks to the lives and the physical and mental health of women who speak languages other than English (LOTE) and who therefore need interpreting support to access antenatal, intrapartum and postnatal care in the United Kingdom. Language barriers have been identified as a significant contributing factor in maternal mortalities and severe morbidities (Cosstick et al. 2022; Cross-Sudworth et al. 2015); and these barriers are associated with poor maternal mental health and wellbeing outcomes (Li 2025a; McLeish & Redshaw 2017). Persistent challenges in providing healthcare interpreting services – particularly in relation to service availability, quality and costs (Li 2025b) – have contributed to a growing interest in the use of video remote interpreting (VRI) as a possible technological solution (Fiedler et al. 2022; Lion et al. 2015).

Given the rapid expansion of video consultations across healthcare systems following the COVID-19 pandemic (Husain & Greenhalgh 2025) and increasing policy and research attention being devoted to remote healthcare interpreting (Saeki et al. 2022; Zhang et al. 2026), VRI is often assumed to be adopted and embedded increasingly in routine care. However, emerging empirical evidence complicates this assumption. Casey et al. (2025), for example, reported a decline in VRI use during the COVID-19 pandemic, attributing this primarily to logistical constraints and pandemic-related service disruptions. Whereas these findings challenge the narratives of linear digital uptake, they offer limited insight into the broader organisational and system-level conditions shaping VRI implementation beyond periods of crisis.

This explanatory gap is evident in the data drawn from the author's doctoral research, which show that VRI accounted for only 11.0% of interpreting encounters delivered by one major interpreting provider at Crossfield Hospital (CSH; pseudonym), an NHS Trust in East London, between 2021 and 2022 (Table 1). Notably, this pattern of adoption persisted despite the widely cited benefits of VRI, including improved access to interpreters (Gilbert et al. 2022), reduced waiting times for LOTE patients (Stevens et al. 2011), enhanced use of non-verbal cues and rapport-building (Schulz et al. 2015) and improved communication quality (Mottelson et al. 2018). These findings suggest that the patterns of VRI adoption cannot be fully explained by short-term disruption or technical constraints alone, pointing instead to deeper multi-domain implementation challenges.

To date, however, few studies have examined the implementation dynamics and organisational conditions that might explain this persistent gap between the anticipated benefits and actual use in maternity care settings. To respond to this gap, this study applies the non-adoption, abandonment, scale-up, spread

Table 1. LanguageLine Solutions’ provision of interpreter-on-wheels (IOW) at Crossfield Hospital 1 (CSH1), 2021–22 (Li 2025a, Vol. 1: 270)

No.	IOW	Calls	%
1	Audio remote interpreting	11,600	88.6
2	Spoken language video remote interpreting	1,434	11.0
3	Sign language video remote interpreting	53	0.4
Total		13,087	100.0

and sustainability (NASSS) framework (Greenhalgh et al. 2017) to examine VRI implementation in UK maternity care. Whereas NASSS has been widely applied to analysing digital health implementation (Abimbola et al. 2019; Greenhalgh et al. 2017, 2018; James et al. 2021), most applications have focused on linguistically homogeneous settings and have paid no attention to interpreting-assisted care. In technology-supported maternity care that is mediated through interpreting, language is not merely a contextual variable but a constitutive factor which shapes the way technologies, professional roles and organisational processes interact. The challenges of implementation in such contexts may therefore cut across multiple NASSS domains rather than being clustered within a single domain. This study focuses on answering one research question: What implementation barriers explain the uneven and poorly understood uptake of VRI in maternity care?

2. Methods

This study applies the NASSS framework retrospectively to an existing dataset through the secondary analysis of data originally collected for a broader doctoral study on the provision of a maternity interpreting service in the UK – including a focused case study of VRI use at CSH (Li 2025a). Unlike most NASSS studies, which adopt a prospective or longitudinal research design, the framework was used here as an analytical lens through which to examine previously collected data.

2.1 NASSS framework

The NASSS framework was developed by Greenhalgh et al. (2017, 2018) to support the analysis of complexity in the implementation of health and care technologies by examining seven interrelated domains: the nature of the condition or illness, the technology, the value proposition, the adopter system, the healthcare

organisation, the wider political and regulatory context, and continuous embedding and adaptation over time (Figure 1).

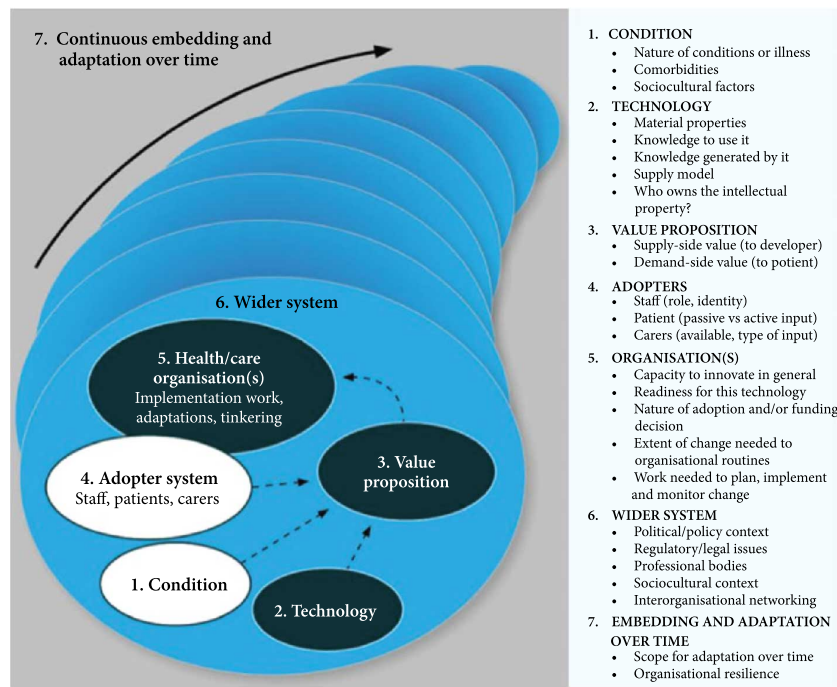


Figure 1. NASSS framework (Abimbola et al. 2019: 2)

The application of NASSS in this study draws on subsequent empirical elaborations of the framework, particularly that by Abimbola et al. (2019), which emphasise sense-making, organisational dynamics and the interaction between complexity and implementation practice. In the NASSS framework, Domain 1 refers to the illness or condition to which the technology is applied. In this study, it is conceptualised as accessing interpreting-assisted maternity care, where language support is required to engage with perinatal services across antenatal, intrapartum and postnatal care rather than with illness per se. Domain 2 refers to the technology itself, including its material properties (such as functionality and dependability), the knowledge needed to use it, the kinds of knowledge it brings into play, its supply model, and questions of ownership and responsibility. In this study, it focuses on the performance of the LanguageLine Solutions (LLS) interpreter-on-wheels (IOW) system in daily maternity care, including its reliability, connectivity, system design, the training needed and the organisational arrangements required to support its use. Domain 3 deals with both supply-side value regarding the commercial and organisational viability of language service providers (LSPs) and NHS organisations and the demand-side value in

respect of the perceived usefulness, safety and effectiveness from the perspectives of LOTE women and their families. In this study, it foregrounds demand-side perspectives to examine not only whether IOW was useful, but also how it was experienced, preferred and evaluated in practice relative to other interpreting modalities. Domain 4 focuses on the adopter system and, in this analysis, it centres on maternity care professionals as the primary adopters of IOW, as they were responsible for deciding when and how the interpreting modalities were to be used in clinical encounters. The interpreters themselves had limited influence over the modality choice (Li 2025a) and are therefore not treated as adopters within Domain 4. Domain 5 examines organisational capacity and readiness, including resources, work routines and implementation processes. Domain 6 situates implementation in the wider institutional, regulatory and sociocultural context. Domain 7 considers the embedding of technology in routine practice and its adaptation over time, including organisational resilience, learning and the capacity for reflexive monitoring, that is, the ability to appraise technology use, learn from implementation experience and adapt practices accordingly (May & Finch 2009).

Following Greenhalgh et al. (2017), each NASSS domain was considered according to whether it exhibited simple, complicated or complex characteristics. Simple phenomena are understood as being relatively predictable and well bounded; complicated phenomena involve multiple interacting components, whose behaviour remains broadly understandable and predictable; complex phenomena are characterised by uncertainty, interdependence, adaptation and non-linear effects.

In this study, these categories were used heuristically to support analytical comparison across domains rather than as fixed classifications. A domain was treated as complex where the empirical data indicated unpredictability, contested meanings or interdependencies that could not readily be disaggregated. Research applying NASSS has shown that interventions characterised by complexity across multiple domains are unlikely to be successfully mainstreamed (Greenhalgh et al. 2017, 2018); this highlights the value of the framework in examining implementation failure across diverse healthcare contexts.

2.2 Interpreter-on-wheels (IOW)

The VRI technology examined in this article (corresponding to Domain 2 of the NASSS framework) was LLS's IOW system (Figure 2) implemented at the participating NHS Trust, CSH. The IOW consists of an iPad mounted on a mobile cart running LLS's InSight interpreting application; it provides on-demand access to audio and video interpreting across multiple languages.



Figure 2. LanguageLine Solutions’ interpreter-on-wheels (IOW) at Crossfield Hospital

2.3 Study design and participants

Whereas the NASSS framework informed the wider research context, it did not structure the original data collection or the initial analysis. The original mixed-methods transformative study was conducted between December 2019 and November 2022 and involved multi-phase data collection using both in-person and remote methods across the UK.

Purposive and snowball sampling ensured representation across linguistic groups, professional roles and geographical locations. CSH was selected due to its high proportion of LOTE patients, established interpreting infrastructure and ongoing implementation of IOW technology. Although three hospital sites were included in the doctoral study, this analysis focuses on CSH1 and CSH2 because CSH3 did not use VRI.

Table 2 provides an overview of stakeholder groups, recruitment, data-collection methods and participant characteristics.

Table 2. Stakeholder groups and characteristics, recruitment methods, data collection, sample size, and participant characteristics and geographic distribution

No.	Stakeholder groups	Key characteristics	Recruitment methods	Data collection & sample size	Participant characteristics	Geographic distribution
1	LOTE women	Women speaking languages other than English as a primary language; accessed UK maternity care between 2008 and 2022	Supporting organisations, community network and gatekeeper-facilitated recruitment	Interviews ($n=10$); focus group ($n=1$, participants $n=13$); ethnographic observations; recruitment period Dec. 2019–Oct. 2022	Languages: Arabic ($n=6$), Mandarin ($n=7$), Kurdish Sorani ($n=3$), Albanian ($n=4$), Spanish ($n=2$), Bengali ($n=1$), Somali ($n=1$); UK residence: six months–15 years; maternity access: 2008–2022	East London, East England, West Midlands, Northern England
2	Support workers	Charitable organisations, third-sector agencies and community groups supporting migrants	Community network	Interviews ($n=10$)	Staff members providing frontline support to migrant families	East England, West Midlands, Northern England
3	Maternity care professionals	Perinatal staff: midwives, obstetricians, sonographers, anaesthetists	Professional associations, social media and CSH	Interviews ($n=5$); questionnaire ($n=41/118$; 35.0% completion rate); follow-up interviews ($n=3$); ethnographic observations	Gender: 85.4% female ($n=35$); Age range: 18–64 years; Professional roles: midwives, obstetricians, sonographers, anaesthetists	London (39.0%, $n=16$); South East (12.2%, $n=5$); Yorkshire & Humber (12.2%, $n=5$); Scotland (12.2%, $n=5$); other regions (23.4%, $n=10$)

Table 2. (continued)

No.	Stakeholder groups	Key characteristics	Recruitment methods	Data collection & sample size	Participant characteristics	Geographic distribution
4	Interpreters	Freelancing interpreters working in healthcare and maternity settings in the UK	Professional associations, LSPs, social media and snowball sampling	Interviews ($n=10$); questionnaire ($n=130/288$; 45.0% completion rate); follow-up interviews ($n=26$); ethnographic observations	Gender: 84.6% female ($n=110$); Professional experience: mean ≈ 14 years; 53.8% with >10 years' experience; Qualifications: Level 6 Diploma (50.8%); Level 3 Certificate (30.8%); Healthcare-specific qualifications: 43.1% ($n=56$) reported none	Primarily UK-wide
5	Bilingual health advocates (BHAs)	Employed by CSH to provide interpreting and advocacy support for LOTE communities	CSH (gatekeeper-facilitated, direct approach, and snowball sampling)	Interviews ($n=5$); survey follow-up interviews ($n=3$); ethnographic observations	All female. Languages represented: Turkish, Russian, Latvian, Arabic, Somali, Panjabi, Urdu, Hindi, Cantonese, Mandarin	CSH
6	Language service providers (LSPs)	LSP representative providing NHS interpreting services	Direct approach to key providers	Interviews ($n=6$); ethnographic observations	Representatives from companies contracted to provide NHS interpreting services	UK-based and international (global interpreter workforce)

Table 2. (continued)

No.	Stakeholder groups	Key characteristics	Recruitment methods	Data collection & sample size	Participant characteristics	Geographic distribution
7	Trainers	Interpreter or doula trainers	Professional associations, networks and snowball sampling	Interviews ($n = 10$)	Interpreter trainers working in higher education or the commercial private sector; doula trainers in commercial or charitable sectors	UK-wide
8	Commissioner	Regional representative with language service oversight	Network-based and targeted recruitment	Interview ($n = 1$)	Regional representative with oversight of language service commissioning and contracts	Regional level

Note. CSH = Crossfield Hospital; LOTE = languages other than English; NHS = National Health Service; LSP = language service provider

Eight stakeholder groups participated: LOTE women who had accessed UK maternity care via interpreting and their family members, migrant support workers, maternity care professionals, interpreters, bilingual health advocates (BHAs), LSPs, interpreter or doula trainers and one commissioner. BHAs are NHS-employed professionals who provide interpreting alongside cultural mediation and patient advocacy, operating within a broader remit than traditional interpreters.

Five data-collection methods were used across different stakeholder groups: semi-structured interviews, surveys (online questionnaires and optional follow-up interviews), ethnographic observations at CSH, a focus group and documentary materials used for contextual and organisational analysis. For LOTE women, interpreting support was provided during the interviews and the focus group when required.

Interviews varied in purpose and format across stakeholder groups, including scoping, semi-structured and follow-up interviews. Interview duration ranged from approximately 20 to 70 minutes ($M=60$ minutes).

The survey research comprised online questionnaires for interpreting service providers (IQ) and maternity care professionals (MQ), followed by optional follow-up interviews conducted between March and October 2022. Respondent identifiers use the suffix “R” (e.g., MQR, IQR) to indicate comments or quotations provided by individual respondents. Square brackets indicate editorial insertions unless they formed part of participants’ original questionnaire responses.

The ethnographic work comprised 118 observation sessions across multiple sites and points in time at CSH, totalling approximately 264 hours onsite from June to November 2022. The observation sessions varied substantially in length, ranging from less than one minute to approximately three hours ($M=39$ minutes).

The two-hour interpreting-assisted focus group with LOTE women was conducted in August 2022 with participants from an established antenatal group. The group comprised nine LOTE-speaking women supported by four interpreters, who participated either in person or online, their interpreting support being provided throughout the discussion. The participants ranged in age from mid-20s to early 40s and they spoke Arabic, Kurdish Sorani, Nicaraguan Spanish and Albanian as their first languages. Those participants who shared the same language were grouped together to support interaction and provide comfort. The interpreters facilitated communication by taking notes during the discussion and providing summary interpreting (Bancroft et al. 2015).

Three interpreters also participated in the discussion, sharing their own lived experiences of interpreting-assisted maternity care. This dual positionality enriched the discussion by foregrounding shared experiential knowledge while also requiring reflexive attention during analysis. The participants were either

pregnant or had given birth in the UK within the previous year and resided in different UK cities. The mediating role and positionality of the interpreters were explicitly considered during the analysis when interpreting the participants' accounts.

The documentary materials included organisational documents, service records and policy-related materials relevant to interpreting provision and VRI implementation.

2.4 Data analysis

The quantitative survey data were analysed using descriptive statistics and were integrated at the interpretation stage to contextualise the qualitative findings and identify patterns of complexity across the stakeholder groups. The qualitative data were analysed using reflexive thematic analysis (Braun & Clarke 2022), supported by NVivo.

The data analysis followed a multi-stage transformative design (Mertens 2003, 2009) in which the data sources were generated and analysed sequentially. The initial qualitative coding was predominantly inductive, using themes from the participants' accounts. In line with the study's transformative orientation, the LOTE women's perspectives were foregrounded in Domain 3 (value proposition) to examine the way in which VRI was experienced with regard to its usefulness, safety and effectiveness, while the maternity care staff were primarily examined within Domain 4 as adopters.

The interview and focus group data informed the analysis in complementary ways. The interviews illuminated individual trajectories and constraints in accessing interpreting-assisted maternity care, while the focus group data highlighted shared concerns and structural patterns across experiences.

Other stakeholder perspectives were interpreted in relation to the LOTE women's accounts, enabling analysis of system-level dynamics while maintaining a central focus on the women.

The present analysis of ethnographic observations focuses on CSH1 and CSH2, where VRI was implemented. A focused ethnographic approach (Muecke 1994) combined participatory and non-participatory observation. Observational data comprised field notes, analytic memos and reflexive notes recorded during and after observation sessions. Ethnographic observations and documentary materials were analysed reflexively alongside the data derived from the interviews, focus groups and survey to interrogate reported practices and organisational narratives and to reveal any tensions, contradictions and contextual constraints shaping the VRI implementation.

NASSS was used as an organising and interpretive lens so as to examine how themes related to different domains of implementation complexity. Consistent with guidance that the framework should support sense-making rather than impose rigid categorisation (Greenhalgh et al. 2017), the domains were used reflexively to explore any interconnections between themes. Theme inclusion was guided by their relevance to the research question, their recurrence across stakeholder groups and their theoretical significance. Reflexivity was maintained through iterative movement between data sources and ongoing reconsideration of the interpretations.

2.5 Ethical considerations

Ethical approval was obtained from the University of East Anglia Ethics Committee (SREC 19–048) and also from the UK Health Research Authority and Health and Care Research Wales (20/WA/0129). Informed consent was obtained from all of the participants using approved procedures, with interpreting support provided where required. Their data were anonymised and stored securely in accordance with the UK General Data Protection Regulation (UK GDPR) and the Data Protection Act 2018.

3. Findings

The following section presents the findings structured around the NASSS framework and applied retrospectively to examine the level of complexity across seven domains of VRI implementation at CSH1 and CSH2.

3.1 Domain 1: The condition

Domain 1, conceptualised as accessing interpreting-assisted maternity care, was characterised by the complexity arising from the interaction between maternity care pathways, language barriers and the socio-cultural factors shaping access to care. The analysis of this domain shows that LOTE women's access to maternity care via VRI involves complexity across two critical dimensions: conflicting stakeholder perspectives on language-support needs and systemic challenges in accurately documenting and matching their language requirements.

3.1.1 *Conflicting stakeholder perspectives on language support needs*

Data analysis revealed differing stakeholder perspectives on the interpreting needs, highlighting tensions across stakeholder groups. LOTE women, support

workers, interpreters and BHAs consistently distinguished between general English competence and LOTE women's capacity to communicate in an additional language during physically and emotionally intense maternity-care encounters. Jamal, an Arabic-speaking woman, explained that the "need [for] an interpreter might not be because you don't speak English [but] might be because of the stress and the [emotional] circumstances ... you are in, so you can't focus" (Focus group, via interpreter).

This perspective was corroborated by Bahar, a doula trainer and interpreter with linguistic expertise, who provided a neurocognitive explanation describing the "labour lens" phenomenon, whereby women revert to their "primal brain" during labour. She explained that "thinking in a foreign language requires our rational brain" and even highly proficient English speakers "just want to revert to their mother tongue" during labour, though they typically "come back to the rational mind" and resume English communication after birth (Interview).

However, tensions emerged between this perspective and institutional efficiency imperatives. When LOTE women appeared to have some English competence, yet insisted on stand-by interpreting¹ arrangements, this created friction with staff efficiency concerns. Marian, a booking midwife at CSH₁, illustrated this tension: "The interpreter will be talking. They [LOTE women] will be answering the interpreter in English. It's not on. It's not good. It's a waste [of resources]" (Observation). She argued that staff could simply "take time to explain everything" directly, making stand-by interpreting redundant. These contrasting perspectives create systemic uncertainty about the use of interpreting criteria, as evidenced by staff expressions of frustration and concerns about resource allocation.

3.1.2 *Language documentation practices and mismatches in language provision*

These stakeholder conflicts are exacerbated by systemic challenges in accurately documenting the requirements for language needs that indicate the interconnected nature of complex conditions. Their English-language proficiency prevented LOTE women from self-reporting accurately via online self-referral forms, particularly for newly arrived migrants who are unfamiliar with the interpreting service provision or the NHS system more broadly. This creates a paradoxical situation: those most needing language support are least able to communicate that need through the existing documentation processes.

1. Drawing on the concept of "stand-by interpreting" from legal settings (Angermeyer 2008; Monteoliva-García 2020), healthcare stand-by interpreting in this study refers to situations in which many participants communicate directly, with an interpreter present to monitor interactions and to intervene when needed rather than interpreting every exchange.

The linguistic complexities extend beyond simple language identification, reflecting how NHS language recording systems are designed from an institutional rather than a user perspective, failing to accommodate the diverse linguistic landscape of service users. These systems conflate ethnicity with language and fail to capture politically sensitive language distinctions. Women may request “Bengali” when they speak “Sylheti” or identify their language as “Portuguese” when they specifically need European Portuguese yet they are matched with Brazilian Portuguese interpreters typically available through some LSPs. Similarly, women had to be recorded as being of “Russian” ethnicity because there was no “Ukrainian” option available at the time of the research. These instances reflect complex political and personal histories that institutional categories cannot capture. As a result, these institutionally designed categorisation systems fail to capture users’ linguistic reality, forcing women to repeatedly explain their language needs at every interaction and creating emergent communication problems that resist systematic prediction. The consequences can be severe: for instance, at CSH1, a woman was provided with a European Portuguese interpreter when she needed Brazilian Portuguese, yet the interpreter did not alert staff to the language mismatch, leaving the woman unable to communicate effectively while the midwives remained unaware that meaningful communication was not taking place. This indicates how communication difficulties often go undetected when interpreters fail to flag dialect or language-variety mismatches, leading to dangerous gaps in care delivery.

Together, these irreconcilable disagreements, documentation failures and language mismatches help to explain why access to interpreting-assisted maternity care could not be straightforwardly stabilised in practice.

Domain 2: The technology

The findings in Domain 2 indicate that VRI implementation at CSH was shaped less by the technical capabilities of the IOW system itself than by its dependence on organisational infrastructure, local practices and staff knowledge. Problems with device reliability, WiFi connectivity, IOW system design and LLS IOW training interacted in ways that made VRI use unpredictable and difficult to stabilise in routine maternity care.

3.2.1 *Reliability and connectivity*

IOW devices at CSH1 exhibited critical reliability problems that deteriorated from 2019 to 2022, producing unpredictable effects on VRI use. Marian, a booking midwife, described the unpredictable nature of these failures: “The wheel [IOW] was working, then all of a sudden it [would] just [make] an echo noise. We will not be

able to hear what they are saying” (Observation). Technical difficulties included sound distortion and unexpected disconnections that required complete session restarts, which indicated how technical problems cascaded into repeated disruptions during interpreting sessions.

Recurring technical failures revealed how VRI performance depended on local WiFi infrastructure, device maintenance and unclear organisational responsibility for support. LLS attributed dropped calls to unreliable WiFi connections or failed attempts at automatic software updates, but this explanation masked a deeper complexity. Midwives were observed struggling to identify the correct WiFi connections from numerous available options, while unreliable networks consistently compromised device effectiveness. Beyond these infrastructure challenges, the absence of clear organisational ownership for routine software updates and hardware maintenance generated additional vulnerabilities, which were exemplified when devices malfunctioned for months and Kemi, the Midwife-in-Charge at CSH1, asked the author at their first meeting: “Do you know who handles it [IOW]? ... We want them to come and check. It is not working properly” (Observation). Despite the LLS’s comprehensive technical support infrastructure, the staff often lacked the knowledge to access these services when problems arose, leaving the available support effectively out of reach.

3.2.2 *System design and workflow disruption*

Beyond infrastructure dependencies, the IOW technology exhibited fundamental design limitations that created paradoxical outcomes. The LLS interpreter dispatching system indicated how seemingly rational technical solutions generate unintended consequences. When calls dropped unexpectedly, reconnecting to the same interpreter proved impossible, forcing staff into inefficient practices. As Kemi described it: “We get a new one [interpreter]. And again ... the [same connection] issue. That’s why my midwife will start again ... We will need the name and the ID ... [It’s] a waste of time. So, midwives refuse to use it” (Observation). This indicates how design flaws create feedback loops where technological limitations generate user resistance, which further undermines the effectiveness of implementation.

3.2.3 *Training and knowledge requirements*

Technology-related challenges were compounded by gaps in training and staff knowledge. At CSH2, IOW training was delivered by LLS as a single 30-minute demonstration session, which many midwives were unable to attend due to clinical demands. Alison, a booking midwife unable to attend, articulated her frustration: “Why couldn’t they knock on my door, and I could get out to the training for three minutes?” (Observation). This inability to access training created a chain

reaction in which Alison subsequently refused even to try the technology, indicating how initial implementation decisions generate long-term resistance patterns.

Taken together, these findings show that VRI performance at CSH emerged from interactions between device design, organisational infrastructure and everyday clinical practice rather than from the technology alone. Seemingly minor factors, such as WiFi selection, unclear maintenance responsibilities or missed training opportunities, produced disproportionate effects on technology use, in these ways contributing to instability and staff resistance.

3.3 Domain 3: Value proposition

Domain 3 examines how the anticipated benefits of VRI were valued in practice across stakeholders. The findings reveal tensions between supply-side value assumptions, particularly commercial and organisational priorities, and demand-side evaluations by LOTE women and their families regarding desirability, effectiveness and safety.

3.3.1 *Commercial and organisational value logics shaping VRI provision*

LLS promoted key benefits through their “pay-as-you-go” model, including cost-efficiency, easy-to-use technology and a comprehensive language coverage with quality (LanguageLine Solutions n.d.a). As Adam, the business development manager at LLS, explained, the model aims to eliminate the perceived “waste”: “The biggest waste of money in interpreting is on-site interpreting when you don’t need on-site interpreting ... You’re paying interpreters quite often just to sit around” (Interview). However, this efficiency logic created vulnerabilities where the expected predictable relationship between spending and service quality broke down in practice.

The most fundamental contradiction lay between LLS’s promise of universal access and global supply chain realities. Adam described LLS as “a global resource” providing “a sustainable interpreting supply” to enable their business model of “24/7 365 for 240 languages” (Interview). However, this international supply model created systemic interdependencies where global resource distribution generated local service failures. These availability failures manifested systematically, contradicting the instant access promise. As one midwife reported: “On numerous occasions I have tried to use LanguageLine to get an interpreter; however, there is no one available to interpret” (MQR44).

As illustrated earlier, even when interpreters were available, geographic assumptions created systematic language mismatches that compromised service appropriateness. The geographic concentration of interpreters produced predictable but problematic defaults. This shows how cost-efficient global sourcing

creates language variant mismatches that undermine the promised comprehensive language coverage.

Even when language variants were appropriately matched, persistent accuracy and quality concerns revealed the gap between LLS’s certification promises and the implementation realities. LLS promoted LanguageLine Certified Medical Interpreters as a quality assurance measure (LanguageLine Solutions n.d.b), yet frontline staff experienced systematic interpreting problems. One midwife noted: “I have been [in] situations where I know the interpreter does not provide [an] accurate interpretation of a conversation. That’s unfair to the patient, and it could be dangerous too” (MQR21).

Survey data from maternity care professionals reported that 61.0% identified interpreters’ lack of medical terminology knowledge as a primary concern (Table 3). It remains unclear how many interpreters had received medical interpreting training through LLS.

Table 3. Interpreters’ negative behaviours reported by maternity care professionals (MQ19)* (Li 2025a, Vol. 1: 174)

Answer choices	Responses	
	(%)	No.
Lack of interpreting skills and competencies, e.g., medical terminologies, accuracy, completeness	61.0	25
Lack of respect for role boundaries, e.g., intervening inappropriately	46.3	19
Unprofessional conduct, e.g., being late	39.0	16
Unprofessional demeanour, e.g., manners, attitudes, attire	31.7	13
Lack of cultural competence	19.5	8
Other	19.5	8
Breaching interpreting Code of Conduct, e.g., confidentiality, impartiality	14.6	6
	Answered	41
	Skipped	0

* MQ19 refers to questionnaire item 19 from the maternity care professionals survey.

Even with technically accurate interpreting, cultural and gender appropriateness created additional layers of service inadequacy that revealed fundamental gaps in LLS’s claims of providing a comprehensive service. Despite LLS’s promoting gender-selection options, cultural knowledge deficits created compound

implementation failures. MQR22, a newly-qualified midwife, described how the booking staff's unfamiliarity with specialised terminology generated culturally harmful outcomes:

I was doing the FGM clinic, and we booked an interpreter and a male turned up ... The interpreting services didn't realise ... because a lot of people don't know what 'FGM' is ... So, the lady ... just put her veil down. And she didn't want to see. She didn't want to talk to him as well. (Survey interview)

This incident illustrates how a booking-level knowledge gap produced culturally inappropriate interpreter assignment.

3.3.2 *LOTE women's evaluations of desirability, effectiveness and safety*

These supply-side problems shaped the way LOTE women evaluated the desirability, effectiveness and safety of VRI. Their "desirability" of VRI reflected constrained necessity rather than genuine choice, with effectiveness and safety systematically compromised by the same workforce infrastructure limitations that undermined the supply-side promises.

This pattern is particularly significant because telephone interpreting is currently the dominant remote modality and already presents substantial barriers for LOTE women. Support workers consistently described their role as advocates in the ongoing struggle to access healthcare interpreting services, with this advocacy role existing precisely because the standard systems consistently failed LOTE women. Poppy, a support worker, characterised booking a telephone interpreting-assisted GP appointment as a "battle": "My goodness, what a battle! What a battle just to make a GP appointment [with interpreters]. It's crazy! Absolutely crazy!" (Interview). This response indicates how apparent technology acceptance can mask systemic service inadequacy.

The evaluation of effectiveness revealed systematic exclusion patterns that further compromised demand-side value. LOTE women were systematically excluded from decisions about technology choice, with observational data indicating that interpreting modality or an interpreter's gender preferences were rarely consulted, limiting their agency in women-centred care delivery. For some LOTE women in this study, the gender of the interpreters does not matter at all, while others prefer only female interpreters for in-person interpreting or for sensitive topics or settings. This exclusion meant that the effectiveness could not be meaningfully assessed. Organisational limitations further compromised effectiveness, as one professional noted, illustrating how resource constraints generate implementation barriers that resist user-centred solutions: "In labour [unsociable] time, only LanguageLine available. Not always easy or possible to use it" (MQR19).

Cultural factors introduced additional layers of complexity that indicated the unpredictable interactions between the use of technology and social contexts. One observed VRI-assisted epidural consent at CSH2 involving a Bengali-speaking woman revealed competing positioning needs: the husband protecting his wife’s dignity according to his religious beliefs by keeping her outside the video frame, while the anaesthetist sought to include her in the conversation. This incident indicated how cultural and religious considerations in intimate health-care contexts create emergent implementation challenges that cannot be resolved through technical improvements alone, but require the use of thoughtful and culturally aware technology.

Safety concerns were linked to significant gaps in interpreter healthcare training. The survey data derived from the interpreters reveal the scope of these deficits: 43.1% reported having no healthcare-specific qualifications (Table 4) and 90.5% had no specialised maternity training. These gap-related problems were compounded by limited transparency regarding the way in which LanguageLine Certified Medical Interpreters aligned with UK healthcare interpreting qualifications, such as Level 3 Community Interpreting and Level 6 Diploma in Public Service Interpreting (DPSI) Health.

Table 4. Healthcare interpreting qualifications (IQ97) (Li 2025a, Vol. 2: 49)

Answer choices	Responses	
	(%)	No.
I do not have one.	43.1	56
Up to 40 hrs’ healthcare interpreting workshops/CPDs	17.7	23
Level 6 DPSI Health	13.9	18
Level 3 in Interpreting (Health)	12.3	16
Other	12.3	16
Healthcare interpreting certificate (over 40 hrs)	6.2	8
MA degree with health-related interpreting modules	6.2	8
BA degree with health-related interpreting modules	3.9	5
I am currently studying for a healthcare interpreting qualification.	1.5	2
PhD degree with health-related interpreting modules	0.0	0
	Answered	130
	Skipped	0

However, responding to these gaps is complicated by structural barriers in the interpreting training system itself. Ada, a university interpreting tutor, highlighted how economic constraints create a cycle that perpetuates under-qualification: “It’s been a struggle ... to get people to come on the course, because ... it costs quite a bit of money ... If you see how much interpreters earn, and then they have to spend time every week ... It’s just not easy” (Interview). This illustrates how economic barriers, limited training access and workforce shortages reinforce one another.

These findings show that value conflicts regarding VRI could not be resolved through technical optimisation or cost-efficiency measures alone. Commercial priorities, organisational constraints and LOTE women’s safety- and preference-based evaluations interacted in ways that generated contradictory outcomes for different stakeholders, resulting in unstable value outcomes for VRI in practice.

3.4 Domain 4: The adopter system

Domain 4 considers maternity care professionals as the primary adopters of VRI. The findings show that training deficits and the complexity of navigating multiple interpreting service-provider arrangements created significant challenges for the practitioners.

The survey data gathered from maternity care professionals revealed that 63.4% had received no training on work with interpreters, while only 9.8% reported VRI-specific training – which means that 90.2% of them were making complex VRI decisions without formal preparation (Table 5). Those with training described undergoing brief 2–4-hour awareness-raising sessions rather than training on selecting appropriate interpreting modalities, often replying instead with regard to informal learning that they were simply to “just ask colleagues on shift” (MQR8).

These training deficits manifested as systematic challenges in choosing appropriate interpreting services that embodied the unpredictable multi-layered nature of complex implementation environments. The maternity care professionals at CSH1 and CSH2 faced multiple interrelated choices about interpreting service-providers (in-house BHAs, local or international freelancing interpreters), interpreting modalities (in-person, audio or video interpreting), devices (IOWs, smartphones, computers), connection methods (landline, mobile network or WiFi) and quality assurance – without adequate preparation or guidance systems. The confusion about provider selection was complicated by inconsistent organisational messaging: IOW devices supplied by LLS displayed the contact details of a different LSP at CSH1, contributing to systematic misidentification in the documentation. Modality selection proved equally complex, with some staff being

Table 5. Maternity care professional training (MQ69) (Li 2025a, Vol. 1: 315)

Answer choices	Responses	
	(%)	No.
None of the above	63.4	26
How to use telephone interpreting (TI) effectively	24.4	10
Working with interpreters effectively	22.0	9
How to use video-mediated interpreting (VMI) effectively	9.8	4
Other	2.4	1
	Answered	41
	Skipped	0

unaware of the available options despite the IOW having been implemented for more than three years. Moreover, different clinical areas developed different preferences: booking midwives favoured BHAs for expertise, while other services prioritised instant on-demand access due to unpredictable language needs. These interconnected decision-making challenges created emerging problems where practitioners developed ad hoc solutions that varied unpredictably across contexts, illustrating the systemic uncertainty characteristic of complex conditions.

Together, these findings show that training gaps and decision-making pressures rendered VRI adoption highly context-dependent. The organisational factors shaping these patterns are examined in Domain 5.

3.5 Domain 5: The organisation

Domain 5 considers the ways in which the organisational arrangements at CSH1 and CSH2 shaped VRI implementation. The findings show that the multi-provider ecosystem at CSH1 created fragmented decision-making processes and coordination challenges across services. This organisational complexity at CSH1 manifests itself through three interdependent dimensions: fragmented decision-making processes across competing service providers, systematic coordination failures between unintegrated systems and multiplied implementation challenges that proliferate throughout the organisation.

Fragmented organisational arrangements resulted in suboptimal decision-making: maternity care professionals contacted services sequentially based on their availability and their own personal preferences rather than on clinical appropriateness or communication effectiveness. This “first available, first used”

approach operated without coordination between systems, with staff being unaware that VRI costs twice as much as audio interpreting. Three frequent VRI users persisted in using it despite the high cut-off rates (18.8%, 15.4%, 14.3% respectively) at the CSH1 Maternity Booking Centre – which suggests habitual rather than effectiveness-based adoption.

These decision-making challenges were overlaid by systematic coordination failures across the ecosystem. Despite services having operated since 2019–2020 to deal with the acute shortage of maternity interpreting services at CSH1, the systems remained unintegrated, with the Bilingual Health Advocacy and Interpreting Service (BHAIS) manager explicitly being excluded from LLS IOW contract decisions, which led to communication gaps that affected service delivery. The BHAIS policy integration failures at CSH1 meant staff navigated different booking systems, interpreter profiles and operational procedures without the benefit of clear guidance. The staff developed ad hoc workarounds instead. For example, booking midwives contacted BHAIS directly, checking the availability of BHAs for specific languages one by one before turning to their preferred external language service provider. In contrast, other maternity services selected providers based on immediate time pressures and device availability rather than following coordinated protocols.

These coordination failures multiplied the implementation challenges, allowing unresolved technical problems to escalate into broader organisational difficulties. The post-COVID emergence of additional providers created further integration difficulties, with competing service models offering different availability patterns: LLS's international interpreter model offered 24/7 availability but reduced NHS system familiarity, while the local provider offered UK-based interpreters with limited availability or coverage; in contrast, the in-house BHAIS operated 17 frequently requested languages with 17 full-time equivalent staff during office hours, creating systematic service trade-offs across the provider landscape. This created unintended equity disparities through a three-tier structure – IOW audio interpreting (24/7, 240 languages), VRI (40 languages, variable hours) and BHAIS in-person or telephone interpreting (17 languages, office hours only) – where service access depended on timing and language requirements rather than clinical or communication needs.

These organisational interdependencies transformed what appeared to be technical or contractual issues into systemic implementation failures, which served to explain why coordination problems persisted across CSH1 and CSH2 despite the repeated efforts to resolve them.

3.6 Domain 6: The wider system

Domain 6 situates VRI implementation within the broader UK healthcare interpreting landscape. The findings highlight the challenges related to policy fragmentation, cost-driven commissioning practices and the absence of professional regulation.

Policy fragmentation across trusts creates systematic barriers to VRI adoption despite the legal duty of the NHS to provide accessible communication for LOTE women. As Keo, a midwife, observed: “The NHS doesn’t work as one coherent unit throughout the whole of the UK. When you work within a specific trust, they have their own layer of policy” (Interview). This fragmentation undermines the implementation of VRI by creating inconsistent standards and procurement approaches across the system. The CSH case illustrates this pattern, with the reactive accumulation of uncoordinated providers reflecting the absence of effective system-wide guidance that forces each trust to reinvent the provision of interpreting services in isolation.

These fragmentation challenges intersect with commissioning practices that prioritise the reduction of costs over service or communication effectiveness and care quality, creating procurement environments that systematically undervalue interpreting services across all modalities. As Adam, the business development manager at LLS, noted: “People want everything in public services. They want rock bottom prices, and they want quality ... At the end of the day, then, they have to see what they can get for that” (Interview). The absence of enforced minimum standards drives well-trained interpreters out of healthcare interpreting to better-paid sectors, which undermines the core workforce needed to implement VRI effectively. Deepak, an LSP1 manager, described how providing unregulated language services affects technology adoption: “Because there isn’t a regulator for language services as a whole ... procurement fills the gap and comes up with weird and wonderful acceptable standards for people to be called ‘interpreters’” (Interview). This regulatory vacuum enabled poor practices among some LSPs, with inadequately trained bilinguals being deployed in healthcare settings, placing LOTE women’s health and wellbeing at risk. These poor practices were corroborated by Kabir (LSP5), who observed inadequate qualification requirements in practice: “Quite a lot of [their] interpreters are not trained or qualified interpreters ... not even Level 3 in many cases, unfortunately” (Interview).

These cost-focused commissioning approaches were aggravated by the absence of dedicated professional organisations of healthcare interpreters in the UK. Without specialised professional bodies that focus specifically on healthcare interpreting, these concerns remain a low priority in general professional associations of interpreters. Organisations such as the National Register of Public

Service Interpreters, the voluntary regulator of interpreters, primarily represent interpreters with Level 6 qualifications, while most healthcare interpreting relies on Level 3 practitioners and it must promote practitioners across multiple public sectors, diluting their focus on healthcare-specific matters. As Deepak explained, the majority of healthcare interpreting is conducted by Level 3 practitioners with limited specialised training: “Level 3 ... is the volume interpreters that take place on the ground, right across ... the health spectrum as a whole” (Interview). This professional infrastructure gap particularly affects emerging technologies such as VRI which require specialised guidance and advocacy to navigate complex healthcare implementation environments; and it forces individual trusts to navigate their implementation without sector-wide learning networks or specialised professional development.

These wider systemic conditions have created an environment in which VRI innovations faced structural adoption barriers, regardless of their technical merit. Policy fragmentation, cost-driven commissioning and regulatory gaps have compounded organisational and adopter-level challenges, limiting the prospects for the sustainable implementation of VRI.

3.7 Domain 7: Adaptation over time

Domain 7 considered whether VRI has become embedded in routine maternity practice and how the system adapted in response to implementation challenges over time. An analysis has shown that VRI implementation at CSH1 and CSH2 face ongoing operational challenges and limited capacity to respond to technical and workflow disruptions.

The capacity to adapt appeared limited, with technical, training and coordination challenges persisting over time. At CSH1, the persistent ineffectiveness in implementing VRI since the 2019–2020 IOW rollout illustrates the limited adaptation observed during implementation, with technical problems, training deficits and coordination challenges recurring without systematic resolution. CSH2’s two-week pilot programme exemplified there was limited evidence that lessons from earlier implementation informed subsequent implementation, replicating as they do identical training inadequacies without incorporating lessons from CSH1’s experience. There was little evidence of reflexive monitoring or systematic learning from implementation challenges, with technical, training and coordination problems recurring across phases without being resolved. Moreover, the multiple provider arrangements led to fragmentation rather than complementary and comprehensive services, which served to point to the structural inflexibility that prevented adaptive coordination. These patterns illustrate the emergent proper-

ties of complex systems, where rational adaptation mechanisms fail due to systemic interdependencies that resist modification.

These adaptation difficulties were combined with deficits in organisational resilience that embodied the fragile context-dependent nature of complex implementation environments. COVID-19 provided a critical test of organisational resilience, revealing insufficient sense-making mechanisms to sustain efficient and effective VRI implementation through environmental disruptions. The pandemic fundamentally disrupted established interpreting workflows at CSH1, displacing in-house BHAs from on-site locations and forcing reliance on on-demand remote services, which were not running smoothly. As the BHAIS manager, Kahina, reflected: “COVID has changed everything for us, because it’s taken us away from the site. It’s put a distance between us and the patient ... We’ve lost some people off our radar” (Interview). While BHAs adapted to predominantly remote telephone interpreting, maternity care professionals’ continued variable uptake of VRI indicated an organisational inability to coordinate adaptive responses across professional groups. These findings suggest uneven resilience across different parts of the system.

These local resilience failures were evident in the incomplete BHAIS policy guidance at CSH1. As mentioned earlier, the BHAIS policy document guided their in-house BHAs team and their long-term local LSP but it did not include LLS on-demand IOW service provision; this created systematic guidance gaps for staff having to navigate their engagement with VRI. This policy incompleteness left practitioners without clear protocols for when and how best to use IOW services, which contribute to the ad hoc decision-making patterns observed across the maternity units at CSH1 and CSH2.

Overall, Domain 7 revealed a failure of embedding and adaptation over time. VRI did not stabilise into routine practice, nor did organisational arrangements co-evolve in response to implementation challenges. Instead, there was limited evidence of reflexive monitoring, while fragmented policy guidance and uneven resilience across professional groups contributed to persistent barriers to learning and adaptation.

4. Discussion

This study set out to explain the uneven and poorly understood uptake of VRI in NHS maternity care by applying the NASSS framework to a multi-stakeholder dataset. Previous studies have attributed low VRI uptake primarily to situational or logistical factors, such as pandemic-related disruptions (Casey et al. 2025). The present analysis builds on these accounts by showing that such proximate

explanations are embedded within wider patterns of workforce, organisational and regulatory complexity that shape the sustainability beyond pandemic-specific conditions.

The findings of this study indicate that VRI implementation at the study site was shaped by interconnected challenges spanning all seven NASSS domains rather than by isolated technical or resourcing issues. Across stakeholder groups, implementation difficulties emerged at the intersection of linguistic diversity, workforce sustainability, organisational arrangements and wider regulatory conditions, producing patterns of complexity that resisted domain-specific solutions. Building on these empirical findings, this discussion advances three interconnected theoretical contributions:

- that linguistic diversity operates as a complexity multiplier across implementation domains;
- that VRI effectiveness depends fundamentally on human interpreter workforce infrastructure; and
- that interpreter-assisted technologies can generate complexity.

Together, these findings extend existing implementation science by indicating how multilingual service contexts influence the patterns of complexity and interdependence in technology adoption.

4.1 Linguistic diversity and cross-domain implementation complexity

The findings of this study indicate that linguistic diversity shaped the implementation challenges across all seven NASSS domains, operating not as a discrete barrier but as an amplifying force that interconnects difficulties across technology, professional practice, organisational processes and system-level governance. Healthcare systems are widely understood as being complex adaptive systems (Braithwaite et al. 2018; Plsek & Greenhalgh 2001). In this regard, the findings of this study indicate that the provision of interpreting services in linguistically diverse maternity settings intensifies this complexity by amplifying uncertainty and interdependence across the implementation domains.

Whereas implementation research has recognised organisational readiness and the implementation climate as possible barriers to change (Damschroder et al. 2009), the findings of this study indicate that linguistic diversity operates at a more fundamental structural level, amplifying uncertainty and interdependence across multiple domains. In this study, linguistic diversity generated cascading effects across the clinical encounter (Domain 1), the availability and usability of technology (Domain 2), perceptions of value and effectiveness (Domain 3) and professional assumptions and practices (Domain 4). Cultural and religious norms

embedded in languages shaped practitioner expectations and interactions, highlighting how linguistic diversity, subsumed under “organisational culture”, exerts distinct operational effects on implementation processes.

These effects extended beyond factors such as time constraints (Parsons et al. 2014), workload (Diamond et al. 2009) or access (Aquino et al. 2015; Tang et al. 2024), producing emergent forms of complexity that could not be predicted by examining language barriers in isolation. This finding extends prior conceptualisations of dynamic system properties (Braithwaite et al. 2018) by showing how language operates as a structural driver of cross-domain complexity in healthcare implementation.

4.2 Interpreter workforce dependency and implementation sustainability

The findings of this study indicate that the effectiveness of VRI in maternity care depends fundamentally on the availability, sustainability and governance of the interpreter workforce. Across stakeholder groups, workforce fragility undermined both the perceived reliability of the technology and the organisational confidence in its use — indicating that technological capability alone is insufficient to stabilise service delivery.

Whereas digital technologies are often promoted as being solutions to access and efficiency challenges, the findings indicate that VRI functions primarily as a connective infrastructure rather than as a service in its own right. As a result, the quality and reliability of interpreter-assisted care depend on interpreter availability, competence and employment conditions, all of which lie largely beyond healthcare organisations’ direct control (Li 2025a, 2025b; NRPSI 2019).

Workforce infrastructure challenges affect all of the interpreting modalities; however, the findings suggest that VRI represents a particularly complex case of implementation in which these challenges intersect with additional technological-, organisational- and system-level dependencies. Telephone interpreting has achieved relatively stable integration into the NHS since the 1990s (Pointon 1996) and is commonly framed as a low-cost and flexible modality within procurement frameworks; however, the evidence indicates that its cost-effectiveness varies substantially according to context (Bridle et al. 2021). VRI builds on this already fragile workforce infrastructure while introducing additional dependencies related to video technology, connectivity, training and coordination across providers. Comparative studies report a higher incidence of technical and connectivity problems in VRI than in telephone interpreting (Schulz et al. 2015; Stevens et al. 2011). In this study, these additional dependencies compounded existing workforce vulnerabilities rather than replacing them, as a result undermining organisational confidence in VRI use further.

At the study site, VRI implementation is characterised by a form of triple dependency that requires coordination between clinical staff, digital infrastructure and a third-party interpreter workforce embedded in a fragmented and weakly regulated service market. Workforce shortages, qualification gaps and cost-driven procurement practices systematically undermine the perceived value and reliability of VRI across multiple NASSS domains. Unlike clinical staff, whose competencies are governed by established regulatory frameworks (Care Quality Commission n.d.), interpreters' qualifications and labour market conditions are shaped by external market dynamics, creating vulnerabilities that healthcare organisations can neither monitor nor resolve internally.

These findings extend earlier work which emphasises the importance of human agency and collective action in implementation processes (Greenhalgh et al. 2004; May et al. 2018) by indicating how workforce dependencies located beyond organisational boundaries can destabilise technology adoption. In interpreter-assisted care, implementation sustainability cannot be achieved through technological optimisation alone but it requires sustained investment in workforce infrastructure, regulation and governance.

4.3 All-domain complexity in VRI services

Finally, the findings show that implementation challenges spanned all seven NASSS domains, with interdependencies between domains producing cascading effects that resisted domain-specific solutions. And whereas prior applications of NASSS have commonly identified complexity in multiple domains (Greenhalgh et al. 2017, 2018), this analysis indicates a pattern of all-domain complexity that appears to be closely linked to the structural characteristics of VRI as an interpreter-assisted service.

Rather than arising from a single dominant constraint, the pattern of all-domain complexity observed in this study reflects the position of VRI as an interpreter-mediated technology embedded at the intersection of language, labour, technology and governance. Because interpreter-mediated services depend simultaneously on human labour, third-party provision, digital infrastructure and regulatory arrangements, the challenges of implementation cannot be contained within individual NASSS domains. Instead, the difficulties develop across domains, producing cumulative effects that resist domain-specific solutions.

Policy and regulatory decisions compounded these dynamics further. Shifts towards lower qualification thresholds and procurement frameworks oriented towards cost-efficiency weakened the interpreter workforce's capacity, leading to downstream effects across organisational functioning, professional practice and patient experience. In the result, technical problems such as device reliability and

connectivity failures became inseparable from organisational infrastructure constraints and national IT policies, producing cascading effects that resisted standardised implementation responses.

These patterns of all-domain complexity are embedded within wider structural conditions that shape healthcare interpreting services. Previous research has shown how cost-driven procurement, fragmented governance and workforce precariousness reinforce one another in a “vicious circle” that is difficult to disrupt (Li 2025b). The present findings indicate how VRI implementation becomes entangled in these dynamics, exposing and intensifying existing system-level constraints rather than resolving them through technological innovation alone.

External shocks such as the COVID-19 pandemic intensified these interdependencies by reshaping the clinical demand, accelerating video-based communication practices, altering staff attitudes and redirecting policy priorities. These synchronised transformations illustrate how implementation unfolds within what Shaw et al. (2018) describe as the “messy reality” of healthcare systems in which multiple domains shift both sequentially and in parallel.

4.4 Practical and policy implications

These theoretical insights have important implications for practice and policy. Healthcare organisations that implement VRI should move beyond single-technology deployment towards ecosystem-level coordination strategies. This includes mapping the population’s language needs prior to procurement, establishing coordination mechanisms between multiple language service providers, integrating the quality assurance of the interpreter workforce into implementation planning and resolving infrastructure dependencies such as connectivity and IT governance.

For policymakers, the findings highlight the systemic risks created by an unregulated healthcare interpreting sector. Evidence-based qualification standards, transparent procurement frameworks and mechanisms for workforce oversight are essential to preventing cost-driven practices from undermining the quality of care. Technology developers and service providers must recognise that VRI implementation is inseparable from interpreter workforce capacity, qualifications and employment conditions; they should therefore design solutions that support these dependencies rather than treating technology as a standalone solution.

5. Conclusion

This study indicates how VRI in maternity care generates an implementation complexity that spans all NASSS domains when situated within linguistically diverse and workforce-dependent service systems. By conceptualising linguistic diversity as a complexity multiplier and foregrounding the interpreter workforce infrastructure as being fundamental to the success of implementation, the analysis extends existing applications of NASSS into multilingual interpreter-assisted healthcare contexts. These findings throw light on the limitations of technology-centred implementation strategies and highlight the need for ecosystem-level coordination and regulation. Understanding and dealing with such interconnected forms of complexity is essential if digital interpreting interventions are to move beyond pilot stages and become sustainably embedded in healthcare practice.

This study examined the provision of maternity interpreting in a single NHS Trust, drawing on data from multiple hospital sites and community support settings. Whereas this multi-site perspective enhances the contextual depth of the study, the findings remain shaped by the organisational arrangements and service pathways of that Trust and by the specific dynamics of maternity care. Their transferability to other clinical specialties and NHS contexts therefore should be considered with caution. Future research using comparative multi-trust designs could explore whether similar patterns of all-domain complexity arise in other interpreter-assisted healthcare settings, including through longitudinal analyses of adaptation over time.

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Data availability statement

The datasets generated and analysed in this study are being deposited in the University of East Anglia's data repository in accordance with the ethical approval requirements and participant confidentiality agreements. Metadata and access conditions are available through the repository. Requests for access may be directed to the author and will be considered in accordance with these requirements and agreements.

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References

-  Abimbola, S., Patel, B., Peiris, D., Patel, A., Harris, M., Usherwood, T. & Greenhalgh, T. (2019). The NASSS framework for ex post theorisation of technology-supported change in healthcare: Worked example of the TORPEDO programme. *BMC Medicine* 17 (1), 1–17.
-  Angermeyer, P.S. (2008). Creating monolingualism in the multilingual courtroom. *Sociolinguistic Studies* 2 (3), 385–404.
-  Aquino, M.R.J.V., Edge, D. & Smith, D.M. (2015). Pregnancy as an ideal time for intervention to address the complex needs of Black and Minority Ethnic women: Views of British midwives. *Midwifery* 31 (3), 373–379.
-  Bancroft, M.A., García-Beyaert, S., Allen, K., Carriero-Contreras, G. & Socarrás-Estrada, D. (Eds). (2015). *The community interpreter: An international textbook*. Columbia, MD: Culture and Language Press.
-  Braithwaite, J., Churrua, K., Long, J.C., Ellis, L.A. & Herkes, J. (2018). When complexity science meets implementation science: A theoretical and empirical analysis of systems change. *BMC Medicine* 16 (1), 1–14.
-  Braun, V. & Clarke, V. (2022). *Thematic analysis: A practical guide*. London: Sage.
-  Bridle, L., Bassett, S. & Silverio, S.A. (2021). “We couldn’t talk to her”: A qualitative exploration of the experiences of UK midwives when navigating women’s care without language. *International Journal of Human Rights in Healthcare* 14 (4), 359–373.
-  Care Quality Commission. (n.d.). *Care Quality Commission: About us*. <https://www.cqc.org.uk/about-us> (accessed 14 Mar 2026).
-  Casey, E.N., Fitzgerald, E., Rackers, H.S., Bates, D., Fox, K. & Bygd, M. (2025). Descriptive analysis of interpreter service mode costs & usage in northwestern Wisconsin pre and peri COVID-19. *BMC Health Services Research* 25 (1), 1–10.
-  Cosstick, E., Nirmal, R., Cross-Sudworth, F., Knight, M. & Kenyon, S. (2022). The role of social risk factors and engagement with maternity services in ethnic disparities in maternal mortality: A retrospective case note review. *eClinicalMedicine* 52, 1–12.

- doi** Cross–Sudworth, F., Williams, M. & Gardosi, J. (2015). Perinatal deaths of migrant mothers: Adverse outcomes from unrecognised risks and substandard care factors. *British Journal of Midwifery* 23 (10), 734–740.
- doi** Damschroder, L. J., Aron, D. C., Keith, R. E., Kirsh, S. R., Alexander, J. A. & Lowery, J. C. (2009). Fostering implementation of health services research findings into practice: A consolidated framework for advancing implementation science. *Implementation Science* 4 (1), 1–15.
- doi** Diamond, L. C., Schenker, Y., Curry, L., Bradley, E. H. & Fernandez, A. (2009). Getting by: Underuse of interpreters by resident physicians. *Journal of General Internal Medicine* 24 (2), 256–262.
- doi** Fiedler, J., Pruskil, S., Wiessner, C., Zimmermann, T. & Scherer, M. (2022). Remote interpreting in primary care settings: A feasibility trial in Germany. *BMC Health Services Research* 22 (1), 1–12.
- doi** Gilbert, A. S., Croy, S., Hwang, K., LoGiudice, D. & Haralambous, B. (2022). Video remote interpreting for home-based cognitive assessments: Stakeholders’ perspectives. *Interpreting* 24 (1), 1–27.
- doi** Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P. & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. *The Milbank Quarterly* 82 (4), 581–629.
- doi** Greenhalgh, T., Wherton, J., Papoutsi, C., Lynch, J., Hughes, G., A’Court, C., Hinder, S., Fahy, N., Procter, R. & Shaw, S. (2017). Beyond adoption: A new framework for theorizing and evaluating Nonadoption, Abandonment, and challenges to the Scale-up, Spread, and Sustainability of health and care technologies. *Journal of Medical Internet Research* 19 (11), 1–21.
- doi** Greenhalgh, T., Wherton, J., Papoutsi, C., Lynch, J., Hughes, G., A’Court, C., Hinder, S., Procter, R. & Shaw, S. (2018). Analysing the role of complexity in explaining the fortunes of technology programmes: Empirical application of the NASSS framework. *BMC Medicine* 16 (1), 1–15.
- doi** Husain, L. & Greenhalgh, T. (2025). Examining intersectionality and barriers to the uptake of video consultations among older adults from disadvantaged backgrounds with limited English proficiency: Qualitative narrative interview study. *Journal of Medical Internet Research* 27, 1–16.
- doi** James, H. M., Papoutsi, C., Wherton, J., Greenhalgh, T. & Shaw, S. E. (2021). Spread, scale-up, and sustainability of video consulting in health care: Systematic review and synthesis guided by the NASSS framework. *Journal of Medical Internet Research* 23 (1), 1–15.
- doi** LanguageLine Solutions. (n.d.a). *On-demand telephone and video interpreting languages*. <https://www.languageonline.com/en-gb/interpreting/interpreting-languages> (accessed 14 Mar 2026).
- doi** LanguageLine Solutions. (n.d.b). *Earn a certificate of competency in medical interpreting*. <https://www.languageonline.com/interpreter-testing-training/medical-interpreter-certification-test> (accessed 14 Mar 2026).
- doi** Li, L. (2025a). Maternity interpreting in the UK healthcare system: An investigation of access, service provision and video-mediated interpreting with multiple stakeholders. PhD dissertation. University of East Anglia.

- doi Li, L. (2025b). The vicious circle: How systemic barriers perpetuate maternity interpreting service inadequacies for migrant women in the UK. *Frontiers in Global Women's Health* 6, 1–16.
- doi Lion, K. C., Brown, J. C., Ebel, B. E., Klein, E. J., Strelitz, B., Gutman, C. K., Hencz, P., Fernandez, J. & Mangione-Smith, R. (2015). Effect of telephone vs video interpretation on parent comprehension, communication, and utilization in the pediatric emergency department: A randomized clinical trial. *JAMA Pediatrics* 169 (12), 1117–1125.
- doi May, C. R., Cummings, A., Girling, M., Bracher, M., Mair, F. S., May, C. M., Murray, E., Myall, M., Rapley, T. & Finch, T. (2018). Using normalization process theory in feasibility studies and process evaluations of complex healthcare interventions: A systematic review. *Implementation Science* 13 (1), 1–27.
- doi May, C. R. & Finch, T. (2009). Implementing, embedding, and integrating practices: An outline of normalization process theory. *Sociology* 43 (3), 535–554.
- doi McLeish, J. & Redshaw, M. (2017). Mothers' accounts of the impact on emotional wellbeing of organised peer support in pregnancy and early parenthood: A qualitative study. *BMC Pregnancy and Childbirth* 17 (1), 1–14.
- doi Mertens, D. M. (2003). Mixed methods and the politics of human research: The transformative-emancipatory perspective. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research*. Thousand Oaks, CA: Sage, 135–164.
- doi Mertens, D. M. (2009). *Transformative research and evaluation*. New York, NY: Guilford Press.
- doi Monteoliva-García, E. (2020). The collaborative and selective nature of interpreting in police interviews with stand-by interpreting. *Interpreting* 22 (2), 262–287.
- doi Mottelson, I. N., Sodemann, M. & Nielsen, D. S. (2018). Attitudes to and implementation of video interpretation in a Danish hospital: A cross-sectional study. *Scandinavian Journal of Public Health* 46 (2), 244–251.
- doi Muecke, M. A. (1994). On the evaluation of ethnographies. In J. M. Morse (Ed.), *Critical issues in qualitative research methods*. Thousand Oaks, CA: Sage, 187–209.
- doi NRPSI. (2019). *NRPSI annual review of public service interpreting in the UK*. <https://www.nrpsi.org.uk/AnnualReview6thEdition> (accessed 14 Mar 2026).
- doi Parsons, J. A., Baker, N. A., Smith-Gorvie, T. & Hudak, P. L. (2014). To 'get by' or 'get help'? A qualitative study of physicians' challenges and dilemmas when patients have limited English proficiency. *BMJ Open* 4 (6), 1–9.
- doi Plsek, P. E. & Greenhalgh, T. (2001). Complexity science: The challenge of complexity in health care. *BMJ* 323 (7313), 625–628.
- doi Pointon, T. (1996). Telephone interpreting service is available. *BMJ* 312 (7022), 53.
- doi Saeki, S., Iwata, M., Tomizawa, R. & Minamitani, K. (2022). Challenges and the potential of promoting remote medical interpreting during COVID-19. *Global Health & Medicine* 4 (6), 341–346.
- doi Schulz, T. R., Leder, K., Akinci, I. & Biggs, B.-A. (2015). Improvements in patient care: Videoconferencing to improve access to interpreters during clinical consultations for refugee and immigrant patients. *Australian Health Review: A Publication of the Australian Hospital Association* 39 (4), 395–399.

-  Shaw, S., Wherton, J., Vijayaraghavan, S., Morris, J., Bhattacharya, S., Hanson, P., Campbell-Richards, D., Ramoutar, S., Collard, A., Hodkinson, I. & Greenhalgh, T. (2018). *Advantages and limitations of virtual online consultations in a NHS acute trust: The VOCAL mixed-methods study*. Southampton: NIHR Journals Library.
-  Stevens, L. A., Mitchell, P. M., Vasquez, J., Lopez, G. M., Gutierrez, A. & McGrath, M. E. (2011). Spanish-speaking patient satisfaction with interpreter services in the emergency department: Comparison of in-person versus live-feed video interpretation. *Annals of Emergency Medicine* 58 (4s), S308.
-  Tang, D., Jawad, D., Dragoje, V., Wen, L. M. & Taki, S. (2024). The use of interpreter services and its barriers faced by hospital staff when accessing interpreters for patients with low English proficiency during the COVID-19 pandemic. *Health Promotion Journal of Australia* 35 (4), 1184–1193.
-  Zhang, W., Davitti, E. & Braun, S. (2026). Charting the landscape of remote medical interpreting: An international survey of interpreters working in remote modalities in healthcare services. *Perspectives* 34 (1), 109–134.

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