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Synopsis

Post-pandemic planning for maternity care for local, regional, and national maternity systems across the four nations: a mixed-methods study

Hiten D Mistry[1,2] Sergio A Silverio[1,3] Emma Duncan[4] Abigail Easter[1] Peter von Dadelszen[1] and Laura A Magee[1*]

[1]Department of Women & Children's Health, King's College London, London, UK
[2]Department of Population Health Sciences, Collage of Life Sciences, University of Leicester, Leicester, UK
[3]Department of Psychology, University of Liverpool, Liverpool, UK
[4]Department of Twin Research & Genetic Epidemiology, King's College London, London, UK

[*]**Corresponding author** laura.a.magee@kcl.ac.uk

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Abstract

Background: During the COVID-19 pandemic, significant reconfigurations were made to maternity care, to deliver this essential service while minimising the risk of infection for pregnant/post partum women and their infants, initially considered to be more vulnerable.

Design: This mixed-methods study had three work packages. Work package 1 used quantitative methods to analyse pregnancy outcomes over time, considering service reconfiguration and inequalities, using routinely collected maternity and offspring data from three diverse South London trusts. Work package 2 involved in-depth interviews with a diverse sample of pregnant/post partum women, partners, healthcare professionals and policy-makers, and used thematic framework analysis. Systematic reviews were undertaken of women's experiences of receiving maternity care during the pandemic, and healthcare professionals' experiences of providing that care. Questionnaires (October–December 2021 and August–September 2022) were administered nationally via the King's College London COVID Symptom Study Biobank, to evaluate vaccine uptake among women who were planning pregnancy, pregnant or post partum. Work package 3 engaged stakeholders within maternity systems through regional Listening Events and a national Policy Lab.

Results:

Work package 1: Among women of reproductive age (8 December 2020–15 February 2021), older age, white ethnicity and a lack of social deprivation were associated with higher vaccine uptake, although ethnicity exerted the strongest effect (Office for National Statistics data). Across pre-pandemic, pandemic with and pandemic without lockdowns, pregnancy outcomes, over time, largely followed pre-pandemic trends (record linkage, South London). However, virtual antenatal care in the second and third trimesters was associated with an excess of adverse pregnancy outcomes (and increased costs).

Work package 2: Our systematic reviews of experiences of receiving (by women) or delivering (by healthcare professionals) maternity care during the pandemic identified the need for personalised care adapted to service users and communities, including those who are marginalised, and including provision of information; and co-design and coproduction of services with service users and staff, to reflect their collective lived experiences. This has the potential to improve workplace well-being for maternity care staff and facilitate inclusive and equitable care for service users. Interviews about COVID-19 vaccination in pregnancy identified a legacy of mistrust, lack of information, and confusing guidance that contributed to vaccine hesitancy for pregnant women during the pandemic. In our national survey, women of reproductive age (including pregnant/post partum women) reported being promptly vaccinated, but with angst and despite having received misinformation and discouragement from some healthcare professionals.

Work package 3: Our programme's findings, published literature and Listening Event discussions led us to focus our Policy Lab on how coproduction can be used in local health systems to substantially improve maternity care over the

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next 2 years. Participants identified barriers to success, set out their vision for what could be achieved and suggested possible actions to progress improvement at a local level.
Study limitations: In our analysis of data for women of reproductive age (from the Office for National Statistics), we lacked data on other potential determinants of vaccination (such as previous COVID-19 or comorbidities). For analysis of pregnancy outcomes (work package 1), limitations include that our study population was only from South London, however diverse, and we did not adjust fully for multiple analyses; however, we consider that our results reflect a coherent pattern of the main processes operating. For our trajectories of virtual antenatal care analysis, a limitation is that those women assigned to the same trajectory are assumed to follow the same pattern of virtual antenatal care. Also, we defined virtual antenatal care as an appointment that was missing blood pressure, dipstick proteinuria and fetal heart rate (after 16 weeks'), without mention of self-monitoring of these parameters at home; however, if blood pressure had been recorded in the observations as part of 'at-home' monitoring during the COVID-19 pandemic, we will have underestimated the prevalence of virtual antenatal care. For our national survey, our participants were not diverse, reflecting the general demographic of ZOE (ZOE Limited, London, UK) app users, limiting generalisability of our findings. For our systematic reviews, we included only English-language papers, but our focus was on studies of the United Kingdom population which are highly likely to be published in English; regardless, no studies for this review were excluded based on language.
Future work: Maternity care is currently in crisis in the United Kingdom. Adopting a maternity system through partnership between those receiving and delivering maternity care could provide solutions necessary to 'build back better', for now and for future health system shocks.
Conclusions: Our findings suggest that maternity care provision, although altered substantially, largely preserved pregnancy outcomes, although experiences of care receipt and delivery were poorer. Costs may have been lower because less care was sought, although virtual (vs. face-to-face) care was more expensive. There is evidence to suggest that the current context of maternity care is of a demoralised and depleted workforce. Implementing a coproduction learning health system could offer needed solutions to improve maternity care delivery, experiences of care and workplace culture, building resilience to withstand future health system shocks.
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Introduction

Please note that some materials are reproduced from the study protocol.

Rationale for research and background

The COVID-19 pandemic, caused by the novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), swiftly spread worldwide, impacting every corner of the globe, with more than 4.3 million cases and 125,000 associated deaths by April 2021. While infection rates continue to fluctuate globally, the period from 30 January 2020 to 5 May 2023 was officially recognised as a pandemic.

Maternity care stands as a fundamental pillar of any healthcare system, including the UK's NHS, and its provision could not be postponed. However, throughout the pandemic, significant adjustments to the delivery of maternity care services were made, responding to local infection rates, lockdown measures and staff shortages. These adaptations aimed to minimise the risk of infection to pregnant and post partum women and their infants, initially considered vulnerable to the virus. The reconfigurations occurred rapidly, were subject to frequent changes and often persisted for extended periods, resulting in fatigue among healthcare workers and confusion among women and their families. While there were adverse pregnancy outcomes related to COVID-19 infection in the approximately 10% who contracted it,[1] there were potential indirect effects on all pregnant women, of the maternity care service reconfigurations.[2]

Objectives

In two trusts providing maternity care in South London [Guy's and St Thomas' NHS Foundation Trust (GSTT) and King's College Hospital NHS Foundation], we aimed to study the impact on women and babies of COVID-19 pandemic-related maternity service configuration (i.e. virtual care, out-of-office monitoring and vaccination), particularly those from minority ethnic groups or leading socially or medically complex lives.

We had three objectives to be addressed by quantitative, social science and policy work packages (WPs):

1. For all pregnancies, to study the impact on maternity care quality (effectiveness, safety and acceptability), maternal and offspring outcomes, and costs within the context of: maternity care service configurations,

particularly: virtual consultations; out-of-office monitoring [e.g. patient-reported blood pressure (BP)]; and COVID-19 vaccination (i.e. provision, uptake and adverse events).
2. Explore and describe the perceptions and experiences of pregnant and post partum women during the pandemic, with a focus on those who: identify with an ethnic minority group; have medical or mental health comorbidities; and/or live with social complexity, including socioeconomic deprivation.
3. Across the four nations, engage with stakeholders to develop policy interventions for local, regional and national health systems.

The RESILIENT study (see logo in *Figure 1*) was funded by the National Institute for Health and Care Research (NIHR), Health and Social Care Delivery Research programme, across the UK's four nations as summarised in *Figure 2*.

Methods for data collection and analysis

Full details of our study protocol can be found on our study website (https://njl-admin.nihr.ac.uk/document/download/2038740). In brief:

- **Work package 1:** QUANTITATIVE methods were used to describe, quantify and explain pregnancy outcomes, using routinely collected, linked maternity and offspring data in the MRC-funded early-LIfe data cross-LInkage in Research – Born in South London (eLIXIR-BiSL) platform (≈60,000 records, 2018–23), from two trusts in an ethnically and socially diverse area, South London. We described and quantified temporal trends in relevant health outcomes and costs (NHS perspective), by service configuration and inequalities (as above), using segmented and individual-level multivariate regression. We sought a coherent pattern of results to be interpreted considering WP2 findings.
- **Work package 2**: SOCIAL SCIENCE was undertaken to enrich our understanding of the quantitative data from WP1. In-depth interviews (IDIs) were conducted with a maximum diversity sample of pregnant/post partum women, partners, care providers and policy-makers, with lived experience of receiving/providing maternity services during the pandemic. The interview schedule explored what changed in care, what it meant to them and whether they were confident about the care received/offered (including vaccination). Analysis was by thematic framework analysis.

- **Work package 3**: STAKEHOLDER ENGAGEMENT was undertaken within local, regional and national maternity

FIGURE 1 The RESILIENT study logo.

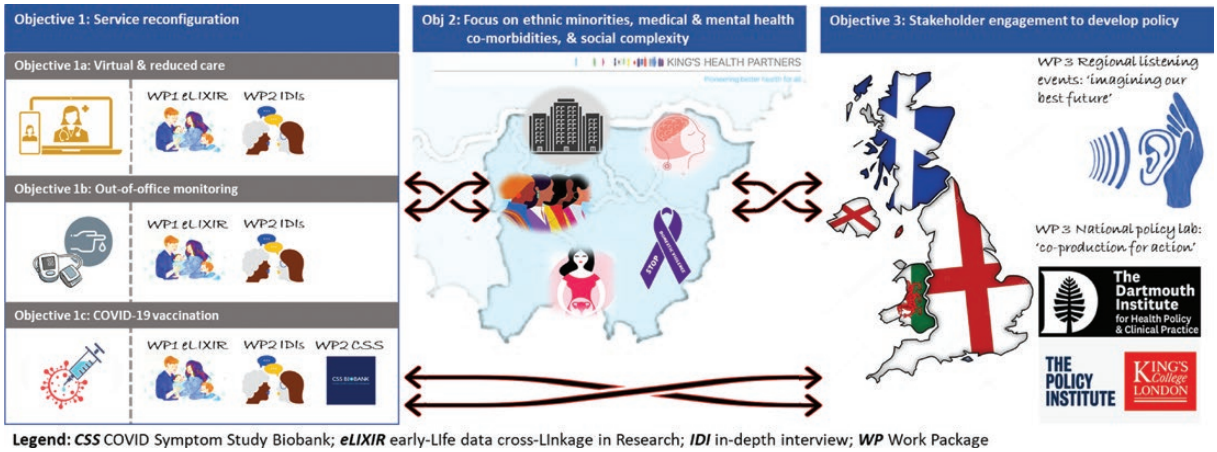

FIGURE 2 The RESILIENT study overview.

systems, to identify lessons learnt, high-impact actions and illustrative case studies. Regional Listening Events ('imagining our best future') were conducted, with representatives from each UK nation to assess WP1 and WP2 evidence; explore what worked and should be retained; what did not work and should be reversed; brainstorm, shortlist and prioritise high-impact future actions; and understand facilitators and barriers to action implementation. A national Policy Lab was planned to further explore the Listening Event findings and produce an 'imagine our best future' report for dissemination. The overarching question for the Policy Lab was: 'How can co-production be used in local health systems to substantially improve maternity care over the next 2 years?'

Results summary

Table 1 provides an overview of the key research papers summarised in this synopsis.

Work package 1: quantitative

National surveillance data analysis of COVID-19 vaccine uptake in England by women of reproductive age

In anticipation of a very delayed data linkage of eLIXIR with the National Immunisation Management System (NIMS), and the realisation that the WP2 surveys were being completed by women who were accepting vaccination, we sought an alternative form of data, from the Office for National Statistics (ONS).

Women of reproductive age (WRA) are a group of particular concern with regard to vaccine uptake, related to their unique considerations of menstruation, fertility and pregnancy. To obtain vaccine uptake data specific to this group, we obtained vaccine surveillance data from the ONS, linked with COVID-19 vaccination status from the NIMS, England, from 8 December 2020 to 15 February 2021. Adjusted effects on vaccine uptake were evaluated by multivariable Poisson models, applied to the counts of events within each stratum. To study effects on any (vs. no) vaccine uptake, a model was designed, incorporating age, ethnicity and Index of Multiple Deprivation (IMD) quintiles as covariates. The effect size was evaluated

TABLE 1 Seven key research papers in our publication plan and summarised in this synopsis

Title	Status
WP1	
National surveillance data analysis of COVID-19 vaccine uptake in England by women of reproductive age	Magee LA, Molteni E, Bowyer V, Bone JN, Boulding H, Khalil A, *et al.*; RESILIENT Study Group. *Nat Commun* 2023;**14**:956. https://doi.org/10.1038/s41467-023-36125-8
Temporal trends in pregnancy outcomes during a health system shock: A retrospective longitudinal study	Tydeman F, Dalrymple KV, McGreevy A, Poston L, Dasgupta T, Easter A, *et al. Research Square*. Preprint (Version 1). https://doi.org/10.21203/rs.3.rs-6886833/v1
The relationship between virtual antenatal care and pregnancy outcomes in a diverse UK inner-city population; A group-based trajectory modelling approach using routine health records	Dalrymple K, Tydeman F, Bone J, Poston L, Dasgupta T, McGReevy A, *et al.* Preprint. https://doi.org/10.21203/rs.3.rs-6800101/v1
WP2	
Women's experiences of maternity care in the United Kingdom during the COVID-19 pandemic: a follow-up systematic review and qualitative evidence synthesis	Dasgupta T, Horgan G, Peterson L, Mistry HD, Balls E, Wilson M, *et al.*; RESILIENT Study Group. *Women Birth* 2024;**37**:101588. https://doi.org/10.1016/j.wombi.2024.02.004
Healthcare providers' experiences of maternity care service delivery during the COVID-19 pandemic in the United Kingdom: a follow-up systematic review and qualitative evidence synthesis	Dasgupta T, Bousfield E, Pathak Y, Horgan G, Peterson L, Mistry HD, *et al.*; RESILIENT Study Group. *Front Glob Womens Health* 2024 Nov 28;**5**:1470674. https://doi.org/10.3389/fgwh.2024.1470674
Courage in decision making: COVID-19 vaccine uptake in women of reproductive age in the U.K	Magee LA, Brown JR, Bowyer V, Horgan G, Boulding H, Khalil A, *et al.*; Covid Symptom Study Biobank Consortium, Resilient Study Group. *Vaccines* 2024;**12**:440. https://doi.org/10.3390/vaccines12040440
Post-pandemic maternity care planning for vaccination: a qualitative study of the experiences of women, partners, healthcare professionals, and policy makers in the United Kingdom	Dasgupta T, Boulding H, Easter A, Sutedja T, Khalil A, Mistry HD, *et al. Vaccines* 2024;**12**(9):1042. https://doi.org/10.3390/vaccines12091042

using incidence rate ratios (IRRs) and 95% confidence intervals (CIs).

Data from 13,128,525 WRA at population level were clustered by age (18–29, 30–39 and 40–49 years), self-defined ethnicity (19 UK government categories) and IMD (geographically defined 'IMD quintiles'). Data analysis identified that among WRA, women of older age (40–49 years, IRR 2.67, 95% CI 2.55 to 2.79), white ethnicity (IRR 0.51, 95% CI 0.49 to 0.53) and being in the least-deprived IMD (IRR 2.06, 95% CI 1.94 to 2.19) are each independently associated with higher vaccine uptake, for first and second doses; however, ethnicity exerts the strongest influence (Black Caribbean, IRR 0.17, 95% CI 0.16 to 0.17; Chinese, IRR 0.25, 85% CI 0.24 to 0.27) (and IMD the weakest).[3]

- Pregnancy outcomes during the COVID-19 pandemic: insights from eLIXIR, Born in South-London (manuscript in preparation)

This study evaluated key maternity indicators and outcomes across pre-lockdown, lockdown and post-lockdown phases of the pandemic, within a sociodemographically diverse population in South London, UK.

Data from the eLIXIR-BiSL cohort were available and included, from 1 October 2018 to 30 June 2023. Included were all pregnancies with data on antenatal registration and delivery information and at least one outcome of interest. Multivariable regression facilitated an ordinal time trend analysis across pandemic phases, while followed by Generalised Additive Modelling figures (GAMs) of each outcome, to visualise trends by month, separated by maternity trust site (designated as 'A' and 'B') and adjusted for confounders. The study epochs were: pre-pandemic (1 October 2018–22 March 2020), pandemic lockdowns (23 March 2020–17 July 2021) and pandemic without lockdowns (18 July 2021–4 May 2022). All models were adjusted for: ethnicity, IMD quintile, gestational age at booking, late booking after 16 weeks' gestation, smoking at booking, nulliparity and prior caesarean. Interactions between study epoch and each of site, ethnicity and IMD were examined.

Thirty-one thousand four hundred and eleven pregnancies were included, 59.6% from Site A, and during epochs: pre-pandemic (*N* = 7706, 24.5%), pandemic with lockdowns (*N* = 10,137, 32.3%) and pandemic without lockdowns (*N* = 13,568, 43.2%). Of 17 outcomes examined, 6 displayed stable temporal trends in outcomes, overall and by site: smoking at birth, preterm birth (PTB), stillbirth, 5-minute Apgar < 7, small- and large-for-gestational-age infants. Seven outcomes displayed linear trends without pandemic influence, either decreasing in event rate (i.e. gestational age at birth, unassisted vaginal birth, assisted vaginal birth, third-/fourth-degree vaginal tears) or increasing in event rate [i.e. accessed NHS Talking Therapy, elective caesarean, post partum haemorrhage (PPH)]; only trends in vaginal tears and PPH were attributable to one site (A and B, respectively). Four outcomes exhibited quadratic or complex trends. Having accessed mental health community contacts dropped during the first lockdown, but increased thereafter at both sites, consistent with care offered by the NHS. Emergency caesarean continued to increase as pre-pandemic, but the increase was more variable at Site B. Event rates were influenced by site differences for two outcomes: labour induction (increased at Site B to mirror rates at Site A, then plateaued), and neonatal intensive care unit (NICU) admission (decreased at Site A only).

The impact of virtual antenatal care on pregnancy outcomes during the COVID-19 pandemic in South London, United Kingdom (manuscript in preparation)

This research aimed to define latent classes of virtual antenatal care (vANC) trajectories over time and explore the impact of those trajectories on pregnancy outcomes.

Antenatal care (ANC) and pregnancy outcome data from mother–child dyads in the eLIXIR-BiSL data linkage cohort were analysed using group-based trajectory modelling (GBTM). ANC was characterised by the number of outpatient contacts, and the proportion that were virtual [based on no recording of BP, proteinuria or fetal heart rate (FHR) after 16 weeks' gestation] during six epochs in pregnancy: 0–14 + 6, 15 + 0–20 + 6, 21 + 0–27 + 6, 28 + 0–32 + 6, 23 + 0–36 + 6 and ≥ 37 + 0 weeks' gestation. In each epoch, the proportion of vANC was grouped into quartiles, and GBTM was used to extract vANC trajectories. Models were assessed using the Akaike and Bayesian information criteria, probability of class assignment, ratio of the odds of correct classification, group membership and entropy. Adjusted multinomial logistic regression was used to assess the relationships between the vANC trajectories and pregnancy outcomes, with confounders identified through direct acyclic graphs, as: IMD, booking gestation, booking hospital, parity and pandemic epoch.

Based on 34,114 mother–child dyads (October 2018–July 2023), GBTM suggested four classes of vANC: 'Trajectory-0': stable over pregnancy, and lowest quartile (*n* = 27,751 pregnancies, 81.3%); 'Trajectory-1': high first

trimester vANC (*n* = 832, 2.8%); 'Trajectory-2': high second trimester vANC (*n* = 2410, 7.1%); and 'Trajectory-3': high third trimester vANC (*n* = 3121, 9.2%). Compared with women Trajectory-0, women who received stable and low vANC, Trajectory-2 was associated with more: PTB < 37 weeks [adjusted relative risk (ARR) 1.21, 95% CI 1.01 to 1.44], labour induction (ARR 1.13, 95% CI 1.02 to 1.25), breech presentation (ARR 1.92, 95% CI 1.02 to 3.62) and PPH (ARR 1.13, 95% CI 1.00 to 1.27); and fewer: assisted vaginal births (ARR 0.87, 95% CI 0.76 to 1.00), female newborns (ARR 0.91, 95% CI 0.84 to 0.99) and fewer diagnoses of gestational hypertension/pre-eclampsia (ARR 0.84, 95% CI 074 to 0.96). Compared with Trajectory-0, pregnancies in Trajectory-3 were associated with more: PTBs < 37 weeks (ARR 1.35, 95% CI 1.16 to 1.58), elective caesareans (ARR 1.54, 95% CI 1.38 to 1.72), emergency caesareans (ARR 1.21, 95% CI 1.01 to 1.34) and NICU admissions (ARR 1.28, 95% CI 1.09 to 1.50); and fewer: third-/fourth-degree vaginal tears (ARR 0.82, 95% CI 0.75 to 0.90), diagnoses of gestational hypertension/pre-eclampsia (ARR 0.84, 95% CI 0.73 to 0.96) and early skin-to-skin contacts made (ARR 0.82, 95% CI 0.73 to 0.92).

Other work

Self-monitoring Self-monitoring was examined through the lens of gestational diabetes mellitus (GDM). During the pandemic, the prior rising rate of GDM diagnosis was attenuated, and GDm-Health app use plateaued at 75–80% of women with GDM. Adjusted analyses are ongoing (e.g. trial emulation) to ascertain the impact of the app use on outcomes, as well as the workforce impact. As GDM women are a minority of the maternity population, this was not anticipated to be a focus of the Policy Lab.

Health economics Little is known about the impact of maternity service reconfigurations on healthcare costs. We aimed to assess the overall impact of the COVID-19 pandemic and its service reconfigurations, including virtual care and self-monitoring, on healthcare cost trajectories and pregnancy costs.

We used a quasi-experimental longitudinal design to analyse data from the eLIXIR-BiSL data platform. We included women with a booking appointment and delivery information, who registered their pregnancy during the following epochs: pre-pandemic (October 2018–February 2020), pandemic with lockdowns (March 2020–June 2021) or pandemic without lockdown (July 2021–April 2023). Pregnancy costs were generated from the NHS perspective, based on individual-level health service use and national unit costs. Health service use included maternity services (routine antenatal appointments, visits to the maternity assessment unit, inpatient stays, delivery and postnatal reviews), primary care consultations and mental health services (NHS Talking Therapy appointments, community contacts and inpatient stays). An interrupted time series analysis was used to assess the impact of the COVID-19 pandemic on monthly mother–newborn costs over time. Cross-sectional per-pregnancy cost models were also calibrated to isolate the impact of virtual care and self-monitoring via the GDm-Health app.

A total of 36,895 pregnancies were included. The level of the monthly pregnancy cost trendline dropped by £38 (95% CI 10 to 65) during pandemic lockdowns (equivalent to 4% of monthly pregnancy costs) and again by £72 (36–108) in the post-lockdown period. There were no significant changes to the slopes of the trendline. This effect varied by ethnicity, with those of black and Asian ethnicity experiencing an increase in costs at the start of the pandemic. Virtual care was found to be associated with higher costs, with a 1% increase in virtual care associated with a £7 (4–10) increase in costs. As the average proportion of virtual care for a pregnancy that had a booking appointment during the pandemic period was 13.4%, compared to 1% in February 2020, this would be a £87 increase in cost per pregnancy. If all 11,470 pregnancies that occurred during the lockdown from our two NHS hospitals in South London received 13.4% of their ANC virtually, the NHS incurred £995,596 additional costs compared to the pre-pandemic use of virtual care. Self-monitoring by women with GDM, using GDm-Health, was found to be cost-neutral.

Work package 2: social science

Qualitative: systematic reviews and in-depth interviews

- Women's experiences of maternity care in the United Kingdom during the COVID-19 pandemic: a follow-up systematic review and qualitative evidence synthesis

Prior research has shown maternity care during the pandemic was negatively experienced by women and led to poor physical and mental health outcomes in pregnancy. We aimed to update a previous systematic review of global maternity care experiences during the pandemic (to June 2021), exploring experiences of maternity care specifically within the UK, and how they may have changed, to inform future maternity services.

We undertook a systematic review of qualitative literature, using comprehensive searches of five electronic databases [Scopus, MEDLINE, EMBASE, Cumulative Index to Nursing

and Allied Health Literature (CINAHL) and PsycInfo® (American Psychological Association, Washington, DC, USA)] and the Cochrane COVID Study Register, published in the UK, between 1 June 2021 and 30 September 2023. Thematic synthesis was utilised for data synthesis.

Of 21,860 records identified, 27 studies were identified for inclusion. Findings included 14 descriptive themes across five RESILIENT core concepts: (1) Care-seeking and experience, with themes of: Impact of restrictions, Experience of motherhood and mental health, and Information and communication with healthcare professional (HCPs); (2) Virtual care, with themes of: Disruption of care and safety concerns, Access to adequate technology, and Improved access to and participation in care; (3) Self-monitoring, with themes of: Control and independence over care, and Issues with implementation; (4) COVID-19 vaccination, with themes of: Positive attitude to vaccines in pregnancy, Vaccine hesitancy, Guidance, communication, and information about the vaccine, and Inequity in vaccine uptake; and (5) Ethical future of maternity care, with themes of: Improving routine maternity care delivery, Information and its dissemination, and Prioritising women's choices.

- Healthcare providers' experiences of maternity care service delivery during the COVID-19 pandemic in the United Kingdom: a follow-up systematic review and qualitative evidence synthesis (*Women and Birth*, submitted MS#: WOMBI-S-24-00592)

We aimed to further our understanding of the impact of maternity service reconfigurations in the UK, from the perspective of maternity HCPs. We updated a previous systematic review of global maternity care experiences during the pandemic (to June 2021), exploring experiences of maternity care service delivery specifically within the UK, to inform future maternity services.

We undertook a systematic review of qualitative literature, using comprehensive searches of five electronic databases (Scopus, MEDLINE, EMBASE, CINAHL and PsycInfo) and the Cochrane COVID Study Register, for relevant studies published in the UK, in English, between 1 June 2021 and 30 September 2023. Data were subjected to thematic synthesis according to key service reconfigurations.

Nine themes were identified according to our five key concepts: (1) Care-seeking and Care Experience, with themes of: Changes to existing care, Limitations placed on the partner, Mental health and lack of support networks, and Barriers to successful implementation of reconfiguration strategies; (2) Virtual Care, with themes of: Impact on quality of care, Increased convenience and flexibility, and Digital exclusion; and (3) Ethical Future of Maternity Care Services, with themes of: Optimising patient care, and Service users (SUs) and staff as the driving force for change. No studies reported on our key concepts of self-monitoring or COVID-19 vaccination.

To our knowledge, this is the only UK-focused systematic review of HCPs' experiences of delivering maternity care during all three COVID-19 pandemic lockdowns.

- Post-pandemic maternity care planning for vaccination: a qualitative study of the experiences of women, partners, healthcare professionals, and policy makers in the United Kingdom (manuscript in preparation for *eClinicalMedicine*)

Maternal vaccination during pregnancy, in general and against COVID-19 infection, offers protection to both mother and baby. However, uptake of vaccines among pregnant women has remained low. This study aimed to explore the perceptions of the offer of COVID-19 vaccination in pregnancy, for women, partners, HCPs and policy-makers, particularly marginalised population groups and those living with social or medical complexity.

Ninety-six semistructured IDIs were conducted with 40 women, 15 partners, 21 HCPs and 20 policy-makers, across all 4 nations of the UK, discussing their lived experience of utilising, delivering or developing policy of COVID-19 vaccination in pregnancy during the pandemic. Thematic framework analysis was used to analyse interview data.

Three themes were derived, namely: (1) Historical and social context; (2) Communication of information and guidance; and (3) Appraisal and action. Together, these described participants' general legacy of mistrust in drugs during pregnancy protective effect of prior positive experiences with vaccines; participants' concerns about missing, conflicting or false information about the COVID-19 vaccine; and the UK government's and NHS's confusing guidance for pregnant women during the pandemic. The final theme describes participants' behaviour and the actions that they took, considering their experiences and the information they had, reasons for vaccine hesitancy or support, and their views towards a future mandatory vaccination program for both SUs and professionals.

Other work

- Post-pandemic maternity care planning for self-monitoring: a qualitative study of the experiences of women, partners, healthcare professionals, and policy makers in the United Kingdom (manuscript in preparation)

This study aimed to explore the perceptions of self-monitoring by women, partners, HCPs and policy-makers, and in particular, marginalised population groups and those living with social or medical complexity.

Across the four nations of the UK, 96 semistructured IDIs were undertaken (as above). Content analysis was undertaken to explore how self-monitoring was conceptualised by participants. Interview data were analysed by thematic framework analysis undertaken to develop themes, with comments considered by participant type, ethnicity, geographical region, personal experience of self-monitoring and social complexity. Also, a content analysis was undertaken of all text to explore how self-monitoring was conceptualised by participants.

Content analysis identified that only women and partners conceptualised self-monitoring as a general awareness of one's body and monitoring for specific clinical signs or symptoms, whereas HCPs and policy-makers understood self-monitoring to include instructions to self-measure using a device.

Two themes and 10 subthemes were derived from interview transcripts: 'Organisational logistics' (subthemes: useful resources and infrastructure, lack of instructions and information provided, communication between HCPs and SUs, logistical issues, HCPs' concerns, personalisation of care) and 'Agency (and responsibility) over care' (subthemes: anxiety and overwhelm, control over care, avoiding hospitals, disengaged users). However, a maximum of 10 (10.4%) participants commented on any 1 subtheme. Low numbers precluded a comprehensive analysis of comments by participant characteristic, but only one black ethnicity participant commented (on disengaged users), and HCPs and policy-makers had particular concerns about workload, quality of assessments and the need to personalise care.

In summary, a minority of participants commented on self-monitoring during the pandemic, despite being asked about it specifically as part of a structured interview schedule. Women and partners conceptualised self-monitoring differently than did HCPs and policy-makers. There are outstanding concerns about the practicalities, including instructions for SUs, communication between SUs and providers, HCP workload, safety and quality of care, and how to manage disengaged users when self-monitoring is used to replace care delivered traditionally face to face.

- The benefits and limitations of virtual care during the COVID-19 pandemic: a qualitative study of the experiences of women, partners, healthcare professionals, and policy makers in the United Kingdom (manuscript in preparation)

As the pandemic has resolved, stakeholders have had time to consider their experiences of virtual maternity care during the COVID-19 health system shock. These reflections are important, as we consider which aspects of virtual delivery are to be retained and incorporated into routine care practice moving forward, which should be abandoned, and which should not be implemented in future health system shocks. We aimed to explore the lived experiences and perceptions of women, partners, HCPs and policy-makers across the UK, regarding virtual delivery of maternity care. We placed specific emphasis on hearing from those in marginalised communities or experiencing social or medical complexity, and how healthcare services could be improved to better cope with future health system shocks.

Ninety-six semistructured IDIs were conducted (as above). Thematic framework analysis was used to analyse interview data.

Analysis of transcript data identified three themes and eight subthemes of: (1) Digital technology, with subthemes of: use of technology, technology infrastructure, and digital poverty; (2) Compromised quality of appointment, with subthemes of: disrupted routine safety checks, compromised quality of personal interaction and care provision, and lack of continued support; and (3) Workforce impact, with subthemes of: perceived benefits, and unreasonable expectations of the workforce. Most often, participants – primarily HCPs and policy-makers – discussed both the benefits of virtual care, and the challenges of maintaining care quality. Of note, disrupted safety checks and compromised quality of the healthcare interaction were endorsed by all participant types. However, concerns about lack of continued support may have been greater in association with self-monitoring or social complexity. That there were unreasonable expectations of the workforce providing virtual care is of note, particularly as views were endorsed by women and

partners, but not by those involved in self-monitoring or with social complexity.

National survey

- Courage in decision making: a mixed-methods study of COVID-19 vaccine uptake in women of reproductive age in the U.K

The COVID-19 vaccination rates are lower in WRA, including pregnant/post partum women, despite their poorer COVID-19-related outcomes. We evaluated the vaccination experiences of 3568 UK WRA, including 1983 women (55.6%) experiencing a pandemic pregnancy, recruited through the ZOE COVID Symptom Study (CSS) app.

Two staggered online questionnaires (October–December 2021: 3453 responders; August–September 2022: 2129 responders) assessed reproductive status, COVID-19 status, vaccination and attitudes for/against vaccination. Descriptive analyses included vaccination type(s), timing relative to age-based eligibility and reproductive status, vaccination delay (first vaccination > 28 days from eligibility) and rationale, with content analysis of free-text comments.

Most responders (3392/3453, 98.2%) were vaccinated by December 2021, motivated by altruism, vaccination supportiveness in general, low-risk and COVID-19 concerns. Few declined vaccination (by September 2022: 20/2129, 1.0%), citing risks (pregnancy-specific and longer-term), pre-existing immunity and personal/philosophical reasons. Few women delayed vaccination, although pregnant/post partum women (vs. other WRA) received vaccination later (median 3 vs. 0 days after eligibility, $p < 0.0001$). Despite high uptake, concerns included adverse effects, misinformation (including from healthcare providers), ever-changing government advice and complex decision-making.

Work package 3: stakeholder engagement

Regional Listening Events

We convened four Listening Events focus group discussions, in November and December 2023, with a median of seven participants and including stakeholders in Scotland, Wales, Northern Ireland and England. Our objective was to understand stakeholder perspectives of these results and how they fit with the maternity system. Specifically, we sought to understand what is working well and what needs to be improved in the UK maternity system and to identify a vision for a maternity system that can deliver the best outcomes, experience and value to mothers and newborns.

Attendees had diverse expertise: parents and partners, clinical (midwifery, doula obstetrics, primary care, mental health), charities and policy-makers; eight additional participants across the four events were unable to attend due to teacher/rail strikes or clinical emergencies (e.g. neonatology).

Our findings were that regional issues were not a strong theme, although the following were mentioned: 'size matters' (for teamwork and access to policy-makers) and the North/South divide in perspective within England. There was little discussion of self-monitoring; empowerment was about education. Stated to have worked well were: digital technology, a cohesive regional approach and dedicated, skilled staff. What could be improved were: trust, personalisation/choice, culture (with many comments about workforce), postnatal care (including not being pressured to breastfeed) and continuity of care (maternity to early years, not focused on midwifery). Vision for the future focused on: equity (but little otherwise about disadvantage), personalisation of care, staff and sustainability, and supportive governance. The transcripts will be analysed qualitatively, for planned publication. These findings were shared with the leaders of the Policy Lab, to inform that process.

National Policy Lab, 'co-production and shared decision-making in maternity services'

In preparation for the Policy Lab, we undertook an additional piece of work, reviewing the maternity investigative ($N = 9$) and strategic ($N = 17$) reports over the last decade. We will summarise these to show the primary themes identified, how they have changed (or not) over time, and their implementability. We are currently in discussion with a representative of the Race and Health Observatory, to combine forces for a summary publication and recommendations for future investigative maternity reports.

Bringing together knowledge to date (i.e. published literature and our mixed-methods findings) with the RESILIENT findings, a potential solution was creation of a coproduction, learning health system. This is a healthcare approach where patients, providers and researchers collaborate to improve care, using real-time data and feedback to continuously learn, adapt and enhance health outcomes. This approach would satisfy the need to create a listening culture, learn from experiences (of women

and HCPs), promote teamwork (for HCPs), support the maternity workforce, promote personalisation of care and prevent misinformation. As such, this was the theme of our Policy Lab.

The Policy Lab was held on 4 April 2024, to identify how a coproduction learning health system could lead to improvement in maternity services. There were 37 attendees, representing HCPs, academics, policy-makers, women and partners with lived experience of maternity services and advocacy groups for a full day of active discussion. They set out their vision for what could be achieved, and suggested possible actions to progress improvement at a local level. The initial summary has been produced, and a 'pyramid analysis' is underway to identify the vertical relationships between key points, below. The output will be a policy brief.

- Creating positive change has proved difficult over the last 20 years, resulting in doubt about what can be achieved quickly.
- A culture of fear has taken the joy from many staff and is not conducive to creating a learning health system.
- Not everyone has the same understanding of what coproduction is or could be, and this can hinder its use and impact.
- The evidence needed to support coproduction should reflect all interests and be presented in neutral terms.
- Reduced levels of trust and a rise in misinformation need to be countered by effective, shared individual decision-making.
- For coproduction to be effective, we need more empowerment for women and staff, and greater transparency in decision-making.

Discussion/interpretation

Principal findings and achievements per project outcome

Work package 1: quantitative

From our *national surveillance data analysis of COVID-19 vaccine uptake in England by* WRA publication, our key finding was that among WRA, women of older age. White ethnicity and being in the least-deprived IMD are each independently associated with higher vaccine uptake, for first and second doses; however, ethnicity exerts the strongest influence (and IMD the weakest).[3]

For examination of *pregnancy outcomes over time*, only for mental health community consultation contacts was there clear evidence of a pandemic lockdown-related change in outcome event probability, for both of our trust data sites. Most outcome event rates followed patterns established pre pandemic, and for the few relevant outcomes, fluctuations in event rates were contextual, attributable to site-specific changes in response to pandemic influences.

For examination of the *impact of virtual care on pregnancy outcomes*, our analysis of eLIXIR-BiSL data found that a policy of increasing vANC above pre-pandemic levels was associated with an excess of adverse pregnancy outcomes, when vANC was provided in the second and third trimesters.

With regard to the impact of maternity service reconfigurations on *costs from an NHS perspective*, the COVID-19 pandemic caused an immediate drop in monthly pregnancy cost trajectories, both when lockdowns were implemented and when they were lifted, potentially reflecting hesitancy to use healthcare services. Virtual care increased costs, and thus, expanding its use in a global context of tight health budgets should be carefully considered, by considering impacts on health outcomes. The cost-neutrality of the use of GDm-Health must be interpreted in light of associated health outcomes and SU experiences.

Other work on *self-monitoring* and *virtual care* highlights the need to be clear on the definition of self-monitoring under study. Although many across our stakeholder groups viewed positively self-monitoring integrated into routine care (as opposed to added to it), there are still outstanding concerns about the practicalities, including instructions for SUs, communication between SUs and providers, HCP workload, safety and quality of care, and how to manage disengaged users when self-monitoring is used to replace care delivered traditionally face to face. For virtual care, participants described both benefits and challenges of virtual maternity care, that should be taken into consideration by policy-makers, along with associated clinical outcomes (less favourable, as below) and *costs* (higher).

Work package 2: social science

Qualitative: systematic reviews and in-depth interviews

In our *systematic review of women's experiences of receiving*[4] *maternity care during the pandemic* (27 studies), 14 descriptive themes were illustrated across 5 RESILIENT core concepts: (1) Care-seeking and experience, with themes of: Impact of restrictions, Experience of motherhood and mental health, and Information and communication with HCPs; (2) Virtual care, with themes

of: Disruption of care and safety concerns, Access to adequate technology, and Improved access to and participation in care; (3) Self-monitoring, with themes of: Control and independence over care, and Issues with implementation; (4) COVID-19 vaccination, with themes of: Positive attitude to vaccines in pregnancy, Vaccine hesitancy, Guidance, communication, and information about the vaccine, and Inequity in vaccine uptake; and (5) Ethical future of maternity care, with themes of: Improving routine maternity care delivery, Information and its dissemination, and Prioritising women's choices. Only one article evaluated experiences of self-monitoring (of BP).

In our *systematic review of HCPs' experiences of delivering maternity care during the pandemic* (Dasgupta *et al.*[5]), our findings highlight HCPs' views of the need for greater inclusion of partners, choice of virtual or in-person care for birthing people; and a need for co-designed services for future policymaking.

In IDIs with women, partners, HCPs and policy-makers, about *COVID-19 vaccination in pregnancy*, our findings identified a legacy of mistrust in vaccines, lack of information about the COVID-19 vaccine and confusing guidance contributed to vaccine hesitancy for pregnant women during the pandemic.

In our *national survey of* WRA *regarding COVID-19 vaccination*, participants reported that they were promptly vaccinated, including pregnant/post partum women. Altruism and community benefit superseded personal benefit as reasons for vaccination. Nevertheless, responders experienced angst and received vaccine-related misinformation and discouragement.

National survey

In a large cohort of volunteer *UK* WRA, *we assessed COVID-19 vaccination* rates, rationale and attitudes. Most participants had promptly accepted vaccination, expressing altruistic and scientifically appropriate reasons. However, qualitative analysis highlighted their courage in making this decision: participants chose vaccination despite doubts about safety, including reproductive concerns. Vaccination decisions were not straight-forward but involved deep personal thought and research. Vacillating government advice and poor advocacy by healthcare providers also challenged women's decisions about vaccination. Vaccination in general, and against SARS-CoV-2 in particular, is critical for public and personal health. Acceptance of vaccination, both by the public and by WRA (including pregnant/post partum women), requires nurturing, along with robust and consistent advice from government and healthcare providers. Our study highlights important lessons for policy-makers and those responsible for public messaging around vaccination.

Work package 3: stakeholder engagement

During the *Listening Events*, regional issues were not a strong theme, although the following were mentioned: 'size matters' (for teamwork and access to policy-makers) and the North/South divide in perspective within England. There was little discussion of self-monitoring; empowerment was about education. Stated to have worked well were: digital technology, a cohesive regional approach and dedicated, skilled staff. What could be improved were: trust, personalisation/choice, culture (with many comments about workforce), postnatal care (including not being pressured to breastfeed) and continuity of care (maternity to early years, not focused on midwifery). Vision for the future focused on: equity (but little otherwise about disadvantage), personalisation of care, staff and sustainability, and supportive governance. A qualitative analysis of transcripts is in progress.

The *Policy Lab* participants identified the barriers to implementing coproduction for maternity services, set out their vision for what could be achieved and suggested possible actions to progress improvement at a local level (see *Introduction*). A policy brief is in preparation.

Contribution to existing knowledge

Work package 1: quantitative

From our *national surveillance data analysis of COVID-19 vaccine uptake in England by* WRA,[3] despite concerns regarding a substantial population of unvaccinated WRA, the absolute rate of first vaccination coverage in WRA in our analysis (78% by February 2022) was higher than observed for the general population in England (70% by September 2022[6]). Our findings should inform future vaccination public messaging and policy, with particular emphasis on messaging appropriate for specific ethnic communities.

Our analysis of *pregnancy outcomes over time* highlights the usefulness of benchmarking between sites, and that, overall, maternity care services were successful in maintaining pre-pandemic levels of pregnancy outcomes, with little evidence of change associated with the pandemic.

Our evaluation of the *impact of virtual care on pregnancy outcomes* has implications for ongoing second- or third-trimester vANC and, specifically, maintenance of largely face-to-face contact during future health system shocks.

Our analysis of the impact of maternity service reconfigurations on *costs from an NHS perspective* contributes to a small body of literature, showing that vANC was not cheaper than face-to-face care, which has implications for the organisation of ANC during future health system shocks.

Work package 2: social science

Qualitative: systematic reviews and in-depth interviews

In our systematic *reviews of women's and HCPs' experiences of receiving*[4] *or delivering* (Dasgupta *et al.*[5]) *maternity care during the pandemic*, undertaken to put our findings into context (amid a rapidly expanding literature on experiences during the pandemic), align with those of SUs and specific groups of HCPs studied by other researchers.

Our findings in the UK were consistent with those globally, and extend those of the previous systematic review, particularly about women's perceptions of the COVID-19 vaccine during pregnancy. This work has the following implications for HCPs and policy-makers:

- Personalisation of maternity care: women desire broader consideration of their specific needs, such as capacity to engage with care, and social and cultural context. This is exemplified by women's mixed experiences of virtual care, which some would choose as a routine component of their care and others would not.
- Inclusiveness of maternity care: this applies to minority ethnic groups, and those who women wish to have involved in their care (e.g. partners). Our rapid transition to using digital health technology during the pandemic leaves a legacy on which to build inclusiveness, and highlights the need for further development of infrastructure, policy and legal/security provisions.
- Presentation of evidence to facilitate pragmatic, informed decision-making: the approach to COVID-19 vaccination in pregnancy has provided us with important learning that is generalisable to maternity care more broadly. Where evidence is lacking, as it so often is when counselling pregnant women about their care options, we can draw on precedent (e.g. experience with other vaccines in pregnancy), the balance of benefits and risks (e.g. disease prevention in a pandemic vs. unknown and only theoretical risks with no hypothesised mechanism), and the value of creating a social norm in pregnancy (e.g. that increases vaccination uptake), applicable to all, including minority ethnic groups and those influenced by misinformation.
- Discussion of the importance of achieving balance: women are invited to complete birth plans, but our findings suggest that planning beyond birth, with respect to time alone and time with family and friends, may promote valuable well-being and infant bonding for both parents. Women may benefit from a postnatal plan which considers their priorities, sets realistic goals specifically with respect to social plans and prepares them to adjust as might be needed.

To our knowledge, ours is the only UK-focused systematic review of HCPs' experiences of delivering maternity care during all three COVID-19 pandemic lockdowns. Our findings that staff had concerns about developing trusting and meaningful relationships with women and birthing people through telephone or video consultation was echoed by SUs, who felt virtual antenatal consultations provided impersonal care and had a negative impact on how much information women and birthing people chose to disclose to their HCP. Our key finding of the challenge faced by staff in fulfilling their duty of care to women and families, in the face of staff shortages and limited resources, is an issue which has been recognised and debated by the UK government (Waitzman E. Staff shortages in the NHS and social care sectors. House of Lords Library. December 2022. Available from: https://lordslibrary.parliament.uk/staff-shortages-in-the-nhs-and-social-care-sectors/; accessed 7 March 2024). Our synthesis suggests that HCPs perceive maternity care should be optimised by providing more choice in care delivery. This should be co-designed with staff and SUs, to reflect their collective experiences and understanding of the context in which they provide and receive care, respectively. This has the potential to improve workplace well-being and maternity staff retention.

In IDIs with women, partners, HCPs and policy-makers, about *COVID-19 vaccination in pregnancy*, our findings suggest that efforts to improve COVID-19 vaccination in pregnancy may be best focused on communication of information. On the other hand, prior positive experiences with other vaccines, both in and outside of pregnancy, positively influences perceptions of the COVID-19 vaccine.

National survey

In our *national survey of* WRA *regarding COVID-19 vaccination*, the COVID Symptom Study Bank (CSSB) survey responders were an early adopter group, and almost all were vaccinated against COVID-19 within 28 days of the vaccine availability to them. However, free-text comments provided in the surveys indicated that women described struggling with their decision, as a result

of discouragement from HCPs, misinformation and ever-changing advice. These findings should inform vaccination strategies in WRA.

Work package 3: stakeholder engagement

Our stakeholder engagement has illustrated a lack of strong regional issues, and the demoralised and depleted nature of HCPs currently providing maternity care.

Strengths and limitations

Strengths

The RESILIENT study was interdisciplinary, with excellent teamwork, within our group and externally (e.g. Parent-Infant coVid OrganisaTional Academic Learning collaborative). Overall, RESILIENT addresses a top priority in trying to build a better maternity service going forward, using the strengths of mixed methods, including health economics, to capture the holistic implications of the pandemic and our response to it, to plan maternity services going forward.

The strengths from the ONS publication (WP1) are the large, comprehensive population-based data set, covering both the first and second doses of the vaccination for WRA in England, using ONS categories for ethnicities and IMD classifications, which allowed a time series analyses. For our analysis of pregnancy outcomes (WP1), we captured outcomes from an ethnically and socioeconomically diverse maternity population in South London. The study outcomes reflect real-world practice and the current situation. For the analysis of outcomes over time, we used a multimodal analytic approach, of multivariable regression, trend analysis and GAMs, allowing us to examine any pattern (linear or non-linear) of outcomes over time, and importantly, distinguishing between ongoing secular trends and pandemic-related changes. We adjusted our analyses for data source (site) and individual-level characteristics, and evaluated potential interactions between confounders and time. To understand the impact of virtual care on pregnancy outcomes, the analytical approach taken was trajectories of vANC, providing a uniquely granular analysis not otherwise seen in the published literature, which has assumed that the pandemic is synonymous with virtual care.

For our IDIs (WP2), we recruited from a geographically representative range of sites across the four UK nations. Also in WP2, our systematic reviews of the relevant literature were comprehensive, and built on a previous review of global literature, allowing us to put the UK into context, as an additional finding. Finally, our national survey of WRA (WP2) gave us a unique perspective on women planning pregnancy and those post partum,[7] using a unique, widely popular COVID-19 app.[8]

Limitations

In our analysis of ONS study for WRA, we lacked data on other potential determinants of vaccination, including: current pregnancy or breastfeeding, previous COVID-19, self-perceived risk of contracting COVID-19, fear of severe infection, presence of comorbidities and/or whether vaccination was offered. For analysis of pregnancy outcomes (WP1), limitations include that our study population was only from South London, however ethnically and socioeconomically diverse, and we did not adjust fully for multiple analyses (by only considering a significant p-value < 0.01, rather than using the very conservative Bonferroni correction); however, we consider that our results reflect a coherent pattern of the main processes operating. For our trajectories of vANC analysis, a limitation is that those women assigned to the same trajectory are assumed to follow the same pattern of vANC. Also, we have defined vANC as an appointment that was missing BP, dipstick proteinuria and FHR (after 16 weeks'), without mention of self-monitoring of these parameters at home; however, if BP had been recorded in the observations as part of 'at-home' monitoring during the COVID-19 pandemic, we will have underestimated the prevalence of vANC.

For our national survey, our participants were not diverse, reflecting the general demographic of ZOE app users,[7] limiting the generalisability of our findings. For our systematic reviews, we included only English-language papers, but our focus was on studies of the UK population which are highly likely to be published in English; regardless, no studies for this review were excluded based on language.

Take-home messages

Work package 1: quantitative

Our *ONS study of COVID-19 vaccination in WRA* indicates that despite free and universal COVID-19 vaccine availability for months, many WRA have remained unvaccinated. The burden of unvaccinated vulnerable women who are most susceptible to severe COVID-19 is disproportionately distributed in women from specific ethnic groupings. Furthermore, a granular non-aggregated approach to vaccination may be needed to improve vaccination coverage among WRA, and by extension, at the time of birth among women who become pregnant.

For our analysis of *pregnancy outcomes over time*, it was clear that maternity care services were successful in maintaining

pre-pandemic levels of pregnancy outcomes, with little evidence of change associated with the pandemic; this is a positive and encouraging message for maternity services which are currently depleted and demoralised.

Our evaluation of the *impact of virtual care on pregnancy outcomes* does not provide reassurance that vANC in proportions higher than pre-pandemic is associated with similar pregnancy outcomes, a sobering message to those planning for future health system shocks.

Our analysis of the impact of maternity service reconfigurations on *costs from an NHS perspective* highlights that most costs arise from labour and delivery, and that, importantly, vANC was not cheaper than face-to-face care.

Work package 2: social science

Qualitative: systematic reviews and in-depth interviews, and national survey

From our *systematic reviews*, key take-home message from women and HCPs is for future maternity care to be:

1. Focused on personalised care that is adapted to individual SUs and communities, particularly marginalised sections of society, both in terms of provision of information and care delivery.
2. Co-design and coproduction of services with SUs and staff to reflect their collective lived experiences. This has the potential to improve workplace well-being for maternity care staff and facilitate inclusive and equitable care for SUs.

Furthermore, in our *national survey of WRA regarding COVID-19 vaccination*, it was clear that WRA planning pregnancy or having had a pregnancy during the pandemic were early adopters of vaccination, but despite a lack of information, misinformation and even discouragement from HCPs. These findings should inform vaccination strategies in WRA. It would be useful to revisit the obligation of the Royal College of Obstetricians and Gynaecologists (RCOG) and Royal College of Midwives (RCM) to follow Joint Committee on Vaccination and Immunisation's direction regarding vaccination recommendations for pregnant and post partum women.

Work package 3: stakeholder engagement

Our Listening Events emphasised the need for *personalisation* and good *communication*, to avoid misinformation and miscommunication.

The Policy Lab identified four priority actions/proposals to increase the use of coproduction in local maternity services:

1. Ensure all digital health transformation is 'fit-or-purpose' and supports coproduction.
2. Disseminate neutral 'non-judgmental' information built through coproduction.
3. Build coproduction into the learning of HCPs.
4. Cultivate the necessary culture for a maternity learning health system.

Reflections: challenges and changes

Work package 1: For eLIXIR-BiSL data linkage, the application process to obtain external data sets held by NHS Digital (now NHS England) – namely Hospital Episode Statistics (HES) and NIMS – is a long and arduous process, wherein we have faced several challenges. Following prompt Data Access Request Service approval for NIMS linkage, we spent 6 months following up regarding next steps, only then to be sent a request for the National Health Services Directory (NHSD) application. Given that King's College London (KCL) already had a data-sharing agreement with NHSD, our NIMS application had to wait for a refresh of the eLIXIR-BiSL HES application. The KCL internal processes were lengthy, and NHSD has had our application since July 2023. We adapted our interest in vaccination data by requesting information from the ONS; this came quickly and without any problems. Human Fertilisation and Embryology Authority linkage was delayed by an update of their electronic systems, and then sign-off of a revised data-sharing agreement between the trusts at King's, related to eLIXIR-BiSL, to bring the working in line with the ethics; this took 16 months and now further.

Work package 2: For our IDIs, we were not able to recruit many ethnic minority policy-makers, but we tried to mitigate potential bias by recruiting a diverse sample in terms of other demographic characteristics, such as professional role, seniority and scope of work. For our national survey, we were not able to use existing data held by the ZOE app to identify women who were planning pregnancy, pregnant or postpartum, as they did not update this information from initial registration.

Work package 3: It was challenging, for both the Listening Events and Policy Lab, to get our desired diversity of attendees, as well as engagement from policy-makers. These issues were exacerbated by the public services unrest, including rail and teaching strikes across the four UK nations. We made key changes to overcome these challenges. We made the Listening Events online [over Zoom (Zoom Video Communications, San Jose, CA, USA)], rather than in-person, and gave those who were unable to make their designated regional meeting the opportunity to attend another. As a result, we had representation from all four UK nations, and diversity with regard to attendance

from women and partners with lived experience, HCPs (including midwives, doulas, obstetricians), stakeholders and policy-makers. To increase attendance for the in-person Policy Lab, we sought assistance from our Technical Advisory Group (TAG) and the wider RESILIENT team, who snowballed personal invitations to their relevant contacts.

Engagement with partners and stakeholders

Work package was focused on stakeholder engagement.

Our institutional capacity-strengthening strategies included regular team online meetings with: our Patient and Public Involvement Advisory Group (PPIE-AG), the core management group, which involved five other academic partners [Applied Research Collaboration (ARC), South London; The Dartmouth Institute for Health Policy & Clinical Practice; the University of Warwick; St George's University of London; and GSTT]; WP members; TAG and Study Steering Committee (SSC). Also, for some IDIs, we used translation services, to improve recruitment of the Bangladeshi community.

Patient and public involvement

Prior to submission of our application, we had a 1-hour meeting with PPIE representatives, to hear about the lived experiences of women with a range of complex maternity histories and how the pandemic and pregnancy care had affected them and their lives. This grounded the study in the complexity of lived experience. This informed the proposal and the drafting of the CSSB survey questionnaire. The eight women included were of diverse ethnicity (i.e. black, *N* = 4; Asian, *N* = 2; White European; White British), and several had experienced subfertility, lived with pre-existing conditions (e.g. hypertension), had pregnancy complications (e.g. gestational diabetes) and/or were experiencing social complexity.

Following our successful NIHR application, PPIE involvement has been embedded throughout the study, by means of our early PPIE meeting at the proposal writing stage, our PPIE lead (Mary Newburn) who was a member of the Core Team and Management Group for the study until August 2023, when Sergio A Silverio took over, our PPIE-AG, and PPIE membership in the multidisciplinary Policy Labs. The Core Team met alternate monthly, and consisted of Laura Magee (chief investigator), Hiten Mistry (senior research fellow and project manager), and the WP leads. Our PPIE-AG meetings are summarised in *Table 2*.

An overview of PPIE activities in RESILIENT, according to Guidance for Reporting Involvement of Patients and the Public 2 (GRIPP2) criteria, is listed in *Table 3*. All GRIPP2 criteria and UK Standards for Public Involvement have been met.

TABLE 2 Details of PPIE engagement

Review stage	PPIE-AG involvement	Nature of meeting and impact on project
November 2021	1 × 1-hour online meeting	Introductions from the Core Team, summary of the planned project and gathered advice that helped shape plans for the study (WP1 and WP2)
February 2022	1 × 1-hour online meeting	Reflected on an update of study progress, provided advice and responses to questions posed by the WP-specific teams, and gave particular input into plans for WP3
June 2022	1 × 1-hour online meeting	Further reflections on study progress and advice gained about challenges and questions posed by WP-specific teams
October 2022	1 × 1-hour online meeting	Reflect on study progress and findings, and provide advice on interpretation of emerging data and their presentation
February 2023	1 × 1-hour online meeting	Gained advice on planning for the regional Listening Events and national Policy Lab (WP3) Continued to reflect on study progress and findings, and provide advice on interpretation of emerging data and their presentation
June 2023	1 × 1-hour online meeting	The groups were presented with analysis of findings from WP1 and WP2 and commented as a critical friend Identified/confirmed agreement on key results to communicate at the Listening Events
January 2024	1 × 1-hour online meeting	Gained advice on plans for the Policy Labs, and reporting emerging public health messages, and use of social media for sharing the results
April 2024	Full-day, in-person Policy Lab meeting	Members of the PPIE with lived experience in using maternity services joined other key stakeholders and HCPs

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TABLE 3 Overview of PPIE in RESILIENT, following GRIPP2 criteria

	WP1	WP2	WP3
1. Aim	Ensure that the research evaluates aspects of maternal physical and mental health, and 'outcome' measures for babies which community members feel are important, in the context of maternity care service reconfigurations, particularly virtual consultations, out-of-office monitoring (e.g. BP and blood glucose), and COVID-19 vaccination (provision and uptake)	Inform the recruitment strategy for IDI participants, to ensure no vital demographic is omitted for each of the four groups: women, partners, healthcare providers and policy-makers	Sense-check the proposal and make suggestions of language use; ask for clarification if anything is unclear
	Ensure that the research places a focus on different ethnic minority groups; have medical or mental health comorbidities; and/or live with social complexity, socioeconomic disadvantage, in areas of deprivation	Ensure the interview schedule for IDI participants is kept to a manageable length and covers priority areas of experience	
	Help the researchers explore concepts of service effectiveness, safety and acceptability		
2. Methods	PPIE have been embedded throughout the study by means of our early PPIE meeting at the proposal writing stage, our PPIE coinvestigator who was a member of the Core Team for the study, our PPIE-AG, and PPIE membership in the multidisciplinary Policy Labs. We were clear not to make assumptions about prior knowledge of the study proposal, or the employment roles of those working on the project, so it was a useful induction tool for public and SUs involved as advisors to the study. The focus of the PPIE-AG was to: • develop and maintain a shared vision with researchers • monitor and address diversity and inclusion • act as a knowledge intermediary through existing connections (e.g. NIHR ARC, South London; Institute of Women and Children's Health, King's Health Partners) and by building new connections (e.g. eLIXIR project's existing ties with community groups in Lambeth and Southwark; contributing trusts) • provide input into interpretation and dissemination of results		
3. Results	We recorded positive experiences and learning about community members' views and experiences of PPIE in RESILIENT, such as these two black PPIE advisers' saying: (1) there is a high level of distrust among ethnic minority communities, and if 'one of our people is named as being part of a research study that goes a long way to addressing distrust'. That, she said, would be her motivation for contributing to papers from the study. She would welcome academic credit. 'For my long-term plans and goals, to be amplified into academic spaces and valued' was of benefit for her. Both felt that as a black-community health and well-being activists, being named on a research paper that they feel says important things about healthcare/maternity care during the pandemic, that will help to address some black people's distrust of research. Moreover, if academic credits are arranged for them, this will have been a positive outcome of PPIE involvement they had		
4. Discussion and conclusions	All results from this study were discussed at the various PPIE-AG meetings. Following this, members were invited to contribute and review all publications, with at least one PPIE member being the contributing coauthor on all papers.		
	For both the Listening Events and the Policy Lab panning, the PPIE-AG and the researchers collaborated in setting up events to shape and share the messages from the study with policy-makers, HCPs, pregnant women/new parents and the public. To support SUs' comfort with participation, we: • arranged a pre-meeting for SUs to explain the purpose of the meetings, how they will work, and to answer any questions; make phone calls to individuals as required, or e-mail; and follow up with phone calls or e-mails, as required		
5. Reflections and critical perspective	At our last PPIE-AG meeting, we chose this to gather feedback on how the members perceived the meetings. Overall, all members commented on how well they felt involved and informed throughout the project, with ample opportunity to voice their thoughts and contribute to the direction of specific areas		
	They all felt that switching from in-person to Zoom meetings allowed them to fully contribute to these meetings, something many would not have been able to do if they were in-person. All were very enthusiastic about continuing to be involved with the outputs, including contributing to current and future publications		

All members worked collaboratively, provided mentoring where required, with the aim of equitable involvement of: voluntary sector organisations, social media networks [e.g. users of Facebook (Facebook, Inc., Menlo Park, CA, USA), Instagram (Instagram Inc., Menlo Park, CA, USA), Twitter (Twitter, Inc., San Francisco, CA, USA)], individual women, at least one partner/father and the ARC PPIE network members.

Training: Women coping with social complexities and challenges may experience multiple traumas, and involvement in research as an adviser, or participating in an interview, can be triggering. As such, joint training was provided for researchers, together with PPIE contributors, on good practice and/or trauma awareness. This was run by Birth Companions charity. Additional training for PPIE-AG members was: signposting to useful resources (first year); frequently asked questions (first year); WhatsApp (Whatsapp, Inc., Menlo Park, CA, USA) group; and ongoing support and encouragement (throughout).

Link with other PPIE ***leaders and good practice***: We drew on and informed the PPIE strategies of the Institute of Women and Children's Health and NIHR ARC, South London, particularly the Maternity and Perinatal Mental Health theme. We used the Innovations in Clinical Trial Design and Delivery for the Under-served guidance and remunerated those who advise us on SU perspectives (through flexible retail vouchers).

In summary, throughout the project, PPIE-AG members contributed through:

- synthesis of results and conclusions and providing feedback to the broader research team, through the PPIE lead and in the form of meeting notes
- writing the PPIE sections of project reports
- contributing to the planning of social media posts
- contributing to the design of interview discussion guides (for IDIs)
- participating in interpretation of results
- reading and contributing to draft reports and journal submissions.

Equality, diversity and inclusion

This study involved data from all four UK nations and covered a diverse population of subjects. Our national recruitment for the IDIs included women from minority ethnic groups and those living complex lives. Our strategy also considered diversity among HCPs and policy-makers. The ZOE-KCL app responders were WRA who were planning pregnancy, pregnant or post partum, to inform broader views about COVID vaccination acceptance and its barriers and facilitators; also, the app had a strong representation across mainland UK, even if not across minority ethnic groups. Although the eLIXIR-BiSL data were from one geographical location (South London), the population studied was diverse – ethnically and socially; this 'over-sampling' of minority group characteristics relative to the national average can be used to contextualise to regions with less diversity or complexity – so-called 'adjusting down'. Understanding regional context, individual and system level, was an important part of preparation for regional and national Listening Events in WP3.

Future research in this field should aim to facilitate patient and public involvement in projects like this through various means, such as face-to-face and online interactions, catering to both individual and group preferences. Diversity among the maternity care workforce should also be considered. This approach will allow for tailored engagement according to individuals' physical abilities, needs and digital literacy levels. Given the subject matter of this synthesis and potentially related studies, it remains crucial to actively engage and maintain connections with marginalised and under-represented groups, including those from ethnic minorities and individuals with various social and medical complications related to maternity services. When interacting with the public and stakeholders, it is important to consider their previous research exposure and knowledge, offering appropriate training and support materials as needed. The dissemination of research findings should be mindful of the needs of vulnerable populations, ensuring that messages are clear and accessible to each group. Moreover, the dissemination strategy should prioritise reaching out to all interested stakeholder groups, especially those that are typically more difficult to engage with.

Impact and learning

Our impact will be broad, on:

- individual patients, through improved care quality (effectiveness, safety, experience) and decision-making for > 600,000 UK pregnancies/year and at least as many women planning
- NHS maternity providers, through strengthened evidence to inform maternity service reconfiguration, including vaccination programmes
- NHS Long Term Plan, through information about implementation of digitally enabled care

- wider society, through innovation to commercialise and decrease direct and indirect societal costs

We anticipate receptiveness to the results given the well-recognised need for improved maternity care services, and the need to plan for future health system shocks. Our strategy includes engagement events that we have held across the four UK nations; our website and social media; preparation of this report, including a plain language summary; and conventional academic outputs, such as presentations at relevant national and international conferences, and publications in high-impact, peer-reviewed, open-access journals. Joint press releases are co-ordinated by the KCL press office with NIHR, participant universities and collaborating trusts.

We will disseminate our findings through an established network of local, regional and national stakeholders. Many of the co-applicants sit on relevant guideline and (national and international) stakeholder committees, including user groups, and will disseminate the findings via this involvement. We will work with national leaders in professional organisations (e.g. RCM, RCOG), charities (e.g. Tommy's, Sands, Birthrights, Fertility Network UK, National Childbirth Trust, Local Maternity Voices Partnership) to target midwifery and lay audiences through specific fora and relevant websites.

Based on findings from RESILIENT study and the wider PIVOT-AL collaborative, we have been short-listed for an NIHR maternity and early-years, 'pregnancy-to-preschool' partnership, focused on workforce flourishing.

Implications for decision-makers

Our Policy Lab brought together RESILIENT findings, evidence from the published literature, in the current UK maternity care context. The four key priority areas identified for decision-makers were:

1. *Ensure all digital health transformation is 'fit-for-purpose' and supports coproduction*

What?

- Hospitals and local health systems should assess their digital transformation work to identify those investments and changes that can best support coproduction. This is especially important for developments that are already underway, so implementation of change considers the importance of generating information that can be used in coproduction conversations and also developing systems/apps that can support high-quality involvement from women, staff and other stakeholders.
- Assessment of digital health transformation should consider the perspectives of SUs and HCPs, as many digital developments are likely to aid participation of both in coproduction work.
- Alongside this, providers should ensure that all digital changes are themselves coproduced, so that both decisions on the overall digital transformation plans and the specific implementation of new systems benefit from a range of perspectives and diverse voices. Even where projects have started, it is not too late to incorporate coproduction principles, to ensure that technology is 'fit-for-purpose' for different stakeholders.
- This includes assessing the huge potential for the use of Artificial Intelligence in developing tools that can assist individual decision-making (e.g. for screening and ultrasound scanning).

Who?

- women [such as via Maternity Voices Partnerships (MVPs), charities and PPIE groups]
- individual hospitals
- local health system leaders
- national digital programme teams
- Royal Colleges/Regulators/NIHR (as other examples of coproduction stakeholders)

How?

- Organise a time-limited process (e.g. focused on a workshop supported by a coproduction process) to define what 'fit-for-purpose' means in maternity. This could be done at a national level or could be a follow-on to the RESILIENT research project.
- Take the ideas on what constitutes 'fit-for-purpose' to local systems, with a recommendation that they undertake a rapid assessment of the digital transformation programme in their areas to:
  - ensure coproduction is being used in the implementation of existing projects, so that these deliver outputs which are fit-for-purpose
  - assess the extent to which digital transformation investments are being designed to provide mechanisms and data that can support future coproduction
  - work at a local system level to help benchmark what is happening across hospitals, primary care and other providers, and start the conversation

in each area about how to align what is being delivered and push up the quality of this where potential shortcomings are identified
- fund support for this work, such as from NHS national programmes or existing third-party funder calls (e.g. Health Foundation). Local systems could also be approached to assess if financial support is available from maternity improvement budgets.

2. *Disseminate neutral 'non-judgmental' information built through coproduction*

What?

- Information on maternity provided to women should learn from those that have done work on prenatal diagnosis of disease, where effective approaches and systems have been developed over decades to generate information that is seen as neutral and 'without-judgement' in the communication of risks and options to women and families (e.g. around decisions related to reproductive choice).
- This information could also be provided in the form of training and education resources for parents to take control of their care. This can build on existing information channels (e.g. adding an education dimension to the Badger app in Scotland, where people already store information on appointments).
- Topics could include information on risks (e.g. high BP) and the choices available to women and their partners. The topics and the information to support these should be coproduced with the full range of stakeholders.
- Women can be asked 'what information matters to them' and HCPs can be asked 'what information can improve shared decision-making' from their perspective. Relevant data could be sourced to inform the conversations, and processes developed to support this at the level of individual clinical interactions.

The aim should be to assemble experts with the right expertise, including:

- Translators and artists with experience of communicating well with women (e.g. through use of videos and other media); and
- Designers and educators who can assist in getting information to people with different learning styles (i.e. visual, aural, kinaesthetic, numbers vs. stories, etc.).
- It is essential to have the 'right people in the room' to take the bold decisions that can avoid the misinformation which led to women dying from COVID-19 because they declined the offer of vaccination.
- Materials should be designed so that they can be tailored easily to local settings and different groups (e.g. based on language, culture).

Who?

- women and families
- translators, artists, designers, educators and other experts in communication
- app developers and other education/information providers
- small number of 'innovator' hospitals

How?

- Undertake an initial mapping of communication practice (e.g. to identify existing resources and exemplars) to find examples of both effective information, as well localities where coproduction is being used effectively in the production of those materials.
- Create a 'coalition of the willing' with a small number of hospitals (or local health systems) to develop a proof of principle in how to develop these materials using coproduction.
- Some trusts which have recently been singled out in enquiries may be keen to participate, as part of rebuilding their reputations.
- The business case should stress the potential for investment in better information to be cost neutral, by generating savings through improvements in the way the maternity system operates and the higher quality of individual journeys and outcomes (including reducing medicolegal risks).
- Put in place an evaluation process after 12 or 24 months to assess the impact of the new information (i.e. its effectiveness in improving outcomes and experiences, and in reducing costs).

3. *Build coproduction into the learning of HCPs*

What?

The aim is to ensure that all maternity staff understand the potential for coproduction and are aware of resources to support this, including:

- understanding the role of MVPs, which are meant to be at the forefront of coproduction but of which many staff are unaware
- learning the skills for listening effectively to staff and women, and how to inject their insights into coproduction work, alongside supporting information (e.g. tools for patient experiences and patient-reported outcomes measures, as well as operational data)
- Training on specific topics should be provided, either as part of the educational curriculum or continuing professional development short courses/online learning (e.g. listening and translation/understanding, undertaking coproduced research, running a quality improvement project using coproduction principles).
- Learning should use creative and experiential methods to communicate effectively and powerfully, and be engaging for all staff – maternity staff but also others, such as healthcare assistants, porters, and administrative staff.
- Coproduction 'champions' could promote this approach within individual trusts and encourage uptake of learning opportunities and resources.

Who?

- women and families
- individual hospitals
- universities/those leading in maternity curriculum development
- charities

How?

- Start small by identifying potential contributors along with decision-makers in education, linking these together in an informal network to drive this project.
- Approach a small number of hospitals to form a network, to help develop and trial new learning resources/methods that increase the understanding and use of coproduction.

4. *Cultivate the necessary culture for a maternity learning health system*

What?

- The objective is to help all local systems cultivate the necessary culture to become an effective maternity learning health system.
- Focus on the benefits that being an effective learning health system can bring, including improved clinical outcomes, reduced safety risks, improved patient and staff experiences, and cost-savings.

Who?

- learning health system experts
- local system leaders
- everyone, as their business

How?

- Identify potential 'early adopter' local health systems.
- Provide support to these to become exemplars of what can be achieved and how other local systems could go about this.

Research recommendations

These were derived from the overall learnings from published literature and our WPs, including the Listening Events and Policy Lab:

1. Develop formal guidance for information communication in maternity care, such as drug or vaccine use in pregnancy, particularly when there are gaps in what is known so that risk is communicated in an accurate, balanced fashion.
2. Assess the extent to which digital transformation investments are being designed to provide mechanisms and data that can support future coproduction.
3. Cultivate the necessary culture for a maternity learning health system, by identifying examplars, through an initial mapping of communication practice (e.g. to identify existing resources) to find examples of both effective information, as well localities where coproduction is being used effectively in the production of those materials.
4. Create a 'coalition of the willing' to form a learning health system, with a small number of hospitals (or local health systems) to develop a proof of principle for how a coproduction learning health system can implement change (such as personalised care) and improve outcomes, experiences (SUs and providers), and reduce costs (including medicolegal).

Conclusions

The COVID-19 pandemic represented a major health system shock to maternity and all healthcare services. Our findings suggest that maternity care provision, although altered substantially, largely preserved pregnancy outcomes, although experiences of care receipt and delivery were poorer. Costs may have been lower because less care was sought, although virtual (vs. face-to-face) care was more expensive. This is a defining moment for maternity care, as our workforce is demoralised and depleted, and recruitable by our countries. Our findings suggest that a coproduction learning health system may provide solutions we seek.

The RESILIENT study group

The RESILIENT study group members are listed in *Table 4*.

TABLE 4 The RESILIENT study group

Chief investigator	
Laura A Magee	Professor of Women's Health, KCL
Co-investigators	
Debra Bick	Professor of Clinical Trials in Maternal Health, Warwick Clinical Trials Unit, University of Warwick
Harriet Boulding	Research Fellow, The Policy Institute at King's, KCL
Peter von Dadelszen	Professor of Global Women's Health, KCL
Kathryn Dalrymple	Lecturer in Nutritional Sciences, KCL
Tisha Dasgupta	Research Associate and PhD Candidate, KCL
Emma L Duncan	Professor of Clinical Endocrinology, Twin Research & Genetic Epidemiology, KCL
Abigail Easter	Reader in Perinatal Mental Health, KCL
Julia Fox-Rushby	Professor of Health Economics, KCL
Gillian Horgan	Operations Assistant, KCL
Asma Khalil	Professor of Obstetrics and Maternal Fetal Medicine, St George's University Hospitals NHS Foundation Trust and Director of Fetal Medicine at Liverpool Women's Hospital NHS Foundation Trust.
Alice McGreevy	Research Assistant in Health Economics, KCL
Hiten D Mistry	Senior Research Fellow, Department of Women and Children's Health, KCL and Department of Population Health, College of Life Sciences, University of Leicester
Eugene Nelson	Professor of Community and Family Medicine, The Geisel School of Medicine at Dartmouth, The Dartmouth Institute, USA
Lucilla Poston, CBE	Tommy's Charity Professor of Maternal & Fetal Health; Head, School of Life Course Sciences, KCL
Paul Seed	Non-clinical Reader in Medical Statistics, KCL
Sergio A Silverio	Research Fellow in Social Science of Women's Health, KCL and Lecturer in Medical Psychology & Lifecourse Health, University of Liverpool
Marina Soley-Bori	Research Fellow, Health economics, KCL
Florence Tydeman	Research Associate in Medical Statistics, KCL
Aricca Van Citters	Senior Research Scientist, The Dartmouth Institute for Health Policy and Clinical Practice, Hanover, USA
Sara White	Tommy's Maternal Diabetes Clinical Research Lead and Clinical Lecturer in Maternal Diabetes, KCL
Ingrid Wolfe	Professor of Paediatrics and Child Population Health, and Interim Head of Department of Women & Children's Health, School of Life Course & Population Sciences, KCL
Wang Yangzhong	Professor of Statistics and Head of Medical Statistics, KCL

This synopsis should be referenced as follows:
Mistry HD, Silverio SA, Duncan E, Easter A, von Dadelszen P, Magee LA. Post-pandemic planning for maternity care for local, regional, and national maternity systems across the four nations: a mixed-methods study. *Health Soc Care Deliv Res* 2025;**13**(35). https://doi.org/10.3310/HHTE6611

Disclaimer

Throughout this report, we follow Royal College of Obstetricians and Gynaecologists' guidance, using 'woman', while acknowledging that optimal maternity services are the right of all, regardless of gender.

Additional information

CRediT contribution statement

Hiten D Mistry (https://orcid.org/0000-0003-2564-7348): Data curation (equal), Writing – editing and reviewing (co-lead).

Sergio A Silverio (https://orcid.org/0000-0001-7177-3471): Conceptualisation (equal), Data curation (equal), Formal analysis (equal), Writing – editing and reviewing (supporting).

Emma Duncan (https://orcid.org/0000-0002-8143-4403): Conceptualisation (equal), Data curation (equal), Formal analysis (equal), Writing – editing and reviewing (supporting).

Abigail Easter (https://orcid.org/0000-0003-4136-3070): Conceptualisation (equal), Data curation (equal), Formal analysis (equal), Writing – editing and reviewing (supporting).

Peter von Dadelszen (https://orcid.org/0000-0002-4462-6537): Conceptualisation (equal), Data curation (equal), Formal analysis (equal), Writing – editing and reviewing (supporting).

Laura A Magee (https://orcid.org/0000-0002-1355-610X): Conceptualisation (lead), Data curation (equal), Formal analysis (equal), Writing – editing and reviewing (lead).

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Patient data statement

This work uses data provided by patients and collected by the NHS as part of their care and support. Using patient data is vital to improve health and care for everyone. There is huge potential to make better use of information from people's patient records, to understand more about disease, develop new treatments, monitor safety, and plan NHS services. Patient data should be kept safe and secure, to protect everyone's privacy, and it's important that there are safeguards to make sure that it is stored and used responsibly. Everyone should be able to find out about how patient data is used. #datasaveslives You can find out more about the background to this citation here: https://understandingpatientdata.org.uk/data-citation

Data-sharing statement

For quantitative data analysis in this project (WP1), all data requests should be directed to the corresponding author for consideration. Access to anonymised data may be granted following review.

For qualitative studies in this project, the data generated are not suitable for sharing beyond that contained within the manuscript. Further information can be obtained from the corresponding author.

Ethics statement

Ethics approval for this study (HR/DP-21/22-26740) was obtained from the King's College London Research Ethics Committee on 10 January 2022 with an amendment to include WP3 (RESCM-22/23-26740) approved on 26 May 2023.

Information governance statement

King's College London is committed to handling all personal information in line with the UK Data Protection Act (2018) and the General Data Protection Regulation (EU GDPR) 2016/679. Under the Data Protection legislation, King's College London is the Data Controller. You can find out more about how we handle personal data, including how to exercise your individual rights and the contact details for our Data Protection Officer here: www.kcl.ac.uk/policyhub/data-protection-policy-2.

Disclosure of interests

Full disclosure of interests: Completed ICMJE forms for all authors, including all related interests, are available in the toolkit on the NIHR Journals Library report publication page at https://doi.org/10.3310/HHTE6611.

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This synopsis was published based on current knowledge at the time and date of publication. NIHR is committed to being inclusive and will continually monitor best practice and guidance in relation to terminology and language to ensure that we remain relevant to our stakeholders.

Study registration

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Award publications

This synopsis provided an overview of the research award *Post-pandemic planning for maternity care for local, regional, and national maternity systems across the four nations*. Other articles published as part of this thread are:

Magee LA, Molteni E, Bowyer V, Bone JN, Boulding H, Khalil A, *et al.*; RESILIENT Study Group. National surveillance data analysis of COVID-19 vaccine uptake in England by women of reproductive age. *Nat Commun* 2023;**14**:956. https://doi.org/10.1038/s41467-023-36125-8

Dalrymple K, Tydeman F, Bone J, Poston L, Dasgupta T, McGreevy A, *et al.* The relationship between virtual antenatal care and pregnancy outcomes in a diverse UK inner-city population; A group-based trajectory modelling approach using routine health records. *Research Square*. 04 June 2025. Preprint (Version 1). https://doi.org/10.21203/rs.3.rs-6800101/v1

Magee LA, Brown JR, Bowyer V, Horgan G, Boulding H, Khalil A, *et al.*; Covid Symptom Study Biobank Consortium, Resilient Study Group. Courage in decision making: a mixed-methods study of COVID-19 vaccine uptake in women of reproductive age in the U.K. *Vaccines* 2024;**12**:440. https://doi.org/10.3390/vaccines12040440

Dasgupta T, Horgan G, Peterson L, Mistry HD, Balls E, Wilson M, *et al.*; RESILIENT Study Group. Women's experiences of maternity care in the United Kingdom during the COVID-19 pandemic: a follow-up systematic review and qualitative evidence synthesis. Women Birth 2024;**37**:101588. https://doi.org/10.1016/j.wombi.2024.02.004

Dasgupta T, Bousfield E, Pathak Y, Horgan G, Peterson L, Mistry HD, *et al.*, The RESILIENT Study Group. Health-care providers' experiences of maternity care service delivery during the COVID-19 pandemic in the United Kingdom: a follow-up systematic review and qualitative evidence synthesis. Front Glob Womens Health 2024;**5**:1470674. https://doi.org/10.3389/fgwh.2024.1470674

Dasgupta T, Boulding H, Easter A, Sutedja T, Khalil A, Mistry HD, *et al.* Post-pandemic maternity care planning for vaccination: a qualitative study of the experiences of women, partners, health care professionals, and policy makers in the United Kingdom. Vaccines 2024;**12**(9):1042. https://doi.org/10.3390/vaccines12091042

Tydeman F, Dalrymple KV, McGreevy A, Poston L, Dasgupta T, Easter A, *et al.* Temporal trends in pregnancy outcomes during a health system shock: A retrospective longitudinal study. *Research Square*. 30 June 2025. Preprint (Version 1). https://doi.org/10.21203/rs.3.rs-6886833/v1

For more information about this research please view the award page https://fundingawards.nihr.ac.uk/award/NIHR134293.

Additional outputs

Conference papers to date

Dasgupta T, Horgan G, Mistry HD, Silverio SA, Magee L. *Postpandemic Maternity Care Planning for Vaccination: Qualitative Findings from Women, Partners, Healthcare Professionals, and Policy Makers in The RESILIENT Study*. BMFMS Annual Conference, Liverpool, UK. 25–26 April 2024.

Dalrymple K, Tydeman F, Poston L, von Dadelszen P, Magee LA. *Implementation of Virtual Antenatal Care During the COVID-19 Pandemic: Impact on Pregnancy Outcomes in the Born-in-South London (BiSL, eLIXIR) Cohort*. BMFMS Annual Conference, Liverpool, 25–26 April 2024.

Tydeman F, Magee L; RESILIENT Study Group. *Pregnancy Outcomes During the COVID-19 Pandemic: Insights from eLIXIR, Born in South-London*. 17th European Public Health Conference, Lisbon, 13–15 November 2024.

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List of abbreviations

ANC	antenatal care
ARC	Applied Research Collaboration
BP	blood pressure
CSS	COVID Symptom Study
CSSB	COVID Symptom Study Bank
eLIXIR-BiSL	early-LIfe data cross-LInkage in Research – Born in South London
GAMs	Generalised Additive Modelling figures
GBTM	group-based trajectory modelling
GDM	gestational diabetes mellitus
GRIPP2	Guidance for Reporting Involvement of Patients and the Public 2
GSTT	Guy's and St Thomas' NHS Foundation Trust
HCP	healthcare professional
HES	Hospital Episode Statistics
IDI	in-depth interview
IMD	Index of Multiple Deprivation
KCL	King's College London
NHSD	National Health Services Directory
NICU	neonatal intensive care unit
NIHR	National Institute for Health and Care Research
NIMS	National Immunisation Management System
ONS	Office for National Statistics
PPH	post partum haemorrhage
PPIE	patient and public involvement and engagement
PPIE-AG	patient and public involvement and engagement advisory group
PTB	preterm birth
RCM	Royal College of Midwives
RCOG	Royal College of Obstetricians and Gynaecologists
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2
SSC	Study Steering Committee
SU	service user
TAG	Technical Advisory Group
vANC	virtual antenatal care
WP	work package
WRA	women of reproductive age

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