Assessment of Primary Care Services Operational Resilience by Patients: Implications for COVID-19 Recovery

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Assessment of primary care services operational resilience by patients: Implications for COVID-19 recovery

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ABSTRACT

While the National Health Service of the United Kingdom recovers from COVID-19, it's crucial to assess the impact of the dynamic capabilities within its healthcare services to ensure future public health protection. This study adopts mixed methods of literature review and surveys. Survey findings reveal that agility, flexibility, and building redundancy proved instrumental in reconfiguring resource foundations swiftly and fostering new partnerships. These actions were essential for sustaining service quality and efficiency. The analysis recommends that patients and healthcare professionals should co-design a technology-driven primary care service provision that is person-centric and digitally inclusive. Furthermore, primary care service stakeholders should develop targeted collaborations, and workforce development should be a priority to increase medical reserve in the healthcare system. This research provides empirical evidence, enabling the National Health Service to persist in enhancing dynamic capabilities and reinforcing resilience for anticipated and unforeseen future challenges.

1. Introduction

Primary care services (PCS) in the United Kingdom provide the first point of contact to patients through general practices (GPs), pharmacies, and dental and optometric services (NHS England, 2022). Responding to the COVID-19 pandemic, PCS made dramatic changes in delivering healthcare services (Lewis et al., 2020), evidencing a high level of operational resilience capability (ORC) in maintaining the continuity of essential health services for the community. As the National Health Service (NHS) operates in the phase of recovery, it is imperative to reflect upon, examine, and learn from specific changes and capabilities that effectively countered challenges posed by the COVID-19 pandemic. The need to respond to crisis, reconfigure sources, and make adaptations will continue in the foreseeable future. Drawing on experience and learning related to dynamic capabilities will inform both critical (responding to high-impact disruptions) and normal service provision response. Therefore, this research aims to gather insights from patients to evaluate PCS operational resilience as a dynamic capability, assessing its effectiveness in sustaining healthcare provision during the COVID-19 pandemic.

The essence of dynamic capabilities lies in an organization's ability to sense and seize opportunities and reconfigure resources in response to changing external environments and internal conditions (Teece, 2007). During the pandemic, many changes were implemented with necessary speed and, thus, without consultation/engagement with the public or patients (Lewis et al., 2020); hence, it is not clear what types of dynamic capabilities created positive (or negative) changes in performance or why (Laaksonen & Peltoniemi, 2018). While PCS recover from COVID-19, it will be valuable to for them to examine the effectiveness of specific dynamic capabilities that can lead to competitive advantages (Ali et al., 2017). Such an examination will provide PCS stakeholders with an evidence-based approach to shaping dynamic capabilities in future crisis management.

This research assesses the resilience of PCS in the most disrupted period (the first lockdown period in the United Kingdom from March to June 2020). Given that patients are the recipients of healthcare services, it would be legitimate to invite them to evaluate the resilience of PCS independently based on their needs and verify their effectiveness in maintaining the standards of healthcare provision.

Drawing on dynamic capability theory, two research questions were investigated.

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(1) From patients' perspective, has PCS resilience restored healthcare service provision to the previous or even an improved performance level as evidenced by the response to the COVID-19 pandemic?
(2) From the perspective of PCS, which dynamic capabilities should be prioritized for future development and investment?

A literature review was performed to analyze various measures taken by PCS to build ORC during the pandemic and to develop a survey questionnaire. The survey assessed patients' experiences in accessing medical service, comparing them before and during the lockdown period through statistical and content analysis. The empirical findings indicate that the resilience capability of PCS maintained healthcare delivery speed but sacrificed quality and effectiveness in some areas.

The paper is structured as follows. The literature is reviewed in Section 2, followed by the development of a proposed resilience framework highlighting the main attributes required to build PCS resilience capabilities. In Section 3, the research methodology is outlined, including data collection and analysis. Using the resilience framework, the adaptations made by PCS in response to COVID-19 are analyzed and evaluated in Section 4. Discussions are presented in Section 5. Section 6 presents conclusions, research limitations, and future work.

2. Literature review

2.1. Evaluating resilience as a dynamic capability

Disruptions and their impacts have been discussed at both the supply chain (SC) level and the organization level (Essuman et al., 2020), with most research focusing on SC level resilience, while fewer studies address resilience at the organizational level (Ambulkar et al., 2015; Essuman et al., 2020). However, the focal organizations' ability to absorb and recover from disruptions can have cascading effects on external SC actors' resilience (Ivanov and Dolgui, 2019). The COVID-19 pandemic has reshaped the NHS PCS landscape, promoting dramatic changes. This includes empowering patients to self-manage their healthcare through multiple service channels, enhancing digital consultation access, building capacity, improving recruitment flexibility, and cutting bureaucracy to reduce workload (NHS England, 2023). This study focuses on the ORC of focal healthcare organizations, that is, GPs and pharmacies as units of analyses, extending the underdeveloped view of ORC within the overall SC system (Essuman et al., 2020).

Dynamic capabilities allow organizations to sense and seize new opportunities, to transform operational or SC design and infrastructure, to achieve alignment with anticipated market shifts, and ultimately to develop operational resilience (Junaid et al., 2023). Prior to the COVID-19 pandemic, the application of dynamic capabilities theory

Table 1
Research using dynamic capabilities theory to improve healthcare resilience.

Context, Literature, and Methods	Year	Disruptions	Attributes of Dynamic Capabilities	Level of Resilience Analysis	Performance	Changes in Performance
Award-winning hospitals in the United States (Murphy and Wilson, 2021; thematic analysis of secondary data)	2016	Competition	Sensing, seizing, and transformation across multiple stakeholder groups	Organization	Organizational cultures promote system-wide engagement by empowering stakeholders, leading to superior performance	Not assessed
General healthcare sector (Furnival et al., 2019, literature review)	2019	Rapid changing environment	Organizational culture, data, and performance, employee commitment, leadership commitment, process improvement and learning, service-user focus, stakeholder and supplier focus, strategy and governance	Organization	Not assessed	Not assessed
Wards in Italian hospitals (Rubbio et al., 2020, within and cross-case studies)	2020	Unexpected events and operational failure	Collaboration, patient specific knowledge absorptive capacity, readiness, flexibility, and response	Organization	Not assessed	Not assessed
Medical device companies in Italy and Finland (Kahkonen et al., 2021; survey and structural equation modeling)	2021	COVID-19	Sensing, Seizing, and reconfiguration	SC	Not assessed	Not assessed
Hospitals in Lithuania, Spain, and the United States (Sermontyte-Baniule et al., 2022, multiple case studies)	2022	COVID-19	Environment scanning, opportunity selection, employee engagement, commercialization of innovation, organizational learning	Organization	Dynamic capabilities contribute to moderate or advanced digital healthcare performance.	Not assessed
Pakistan healthcare SC organizations (Junaid et al., 2023, structural equation modeling)	2023	COVID-19 and sustainability	Learning, sensing, and coordinating	SC	Technology-enabled dynamic capabilities have a direct positive impact on SC resilience and sustainable SC performance	Not assessed
Italian hybrid public and private hospitals (Rubbio & Bruccoleri, 2023,structural equation modelling)	2023	Unexpected events and operational failure	Patient specific knowledge absorptive capacity	Organization	Not assessed	Not assessed
Public health sector organizations (Loureiro et al., 2023, questionnarie, multivariate analysis)	2023	General performance evaluation	Marketing, technology, and operations capabilities Innovation capabilities Knowledge capabilities	Organization	Not assessed	Not assessed
This study—Primary care services in the United Kingdom (Survey, χ^2 analysis, content analysis)		COVID-19	Seizing opportunities (agility); reconfiguring resources and skills (flexibility and redundancy)	Organization	Not assessed	Changes in organizational performance are assessed by patients

within the public sector was very limited, apart from Furnival et al. (2017, 2019), who employed dynamic capabilities to construct a conceptual framework encompassing eight dimensions to improve the capabilities of the healthcare sector (see Table 1). During and after the COVID-19 pandemic, there was a surge in research applying dynamic capacities theory in the context of healthcare to develop resilience (Kahkonen et al., 2021) and maintain competitiveness (Murphy & Wilson, 2022). To provide a holistic view of how dynamic capabilities are applied in different healthcare settings and their effectiveness in addressing varying crises, Table 1 compares recent studies that apply dynamic capabilities to improve resilience in the healthcare sector. The comparison is made under six aspects business context under investigation, types of disruptions, dynamic capabilities and their attributes, level of resilience analysis, impacts of dynamic capabilities on performance, and performance changes.

Organizational resilience (Essuman et al., 2020) and SC resilience (Mandal, 2017) have both been conceptualized as dynamic capabilities across various levels of analysis. The core elements of dynamic capabilities, including sensing capability, seizing capability, and transforming/reconfiguring capability, have been adopted widely as theoretical foundations for formulation of capabilities for enhancing healthcare resilience, as reported in many studies in Table 1. Among these studies, some researchers have examined how dynamic capabilities enhance organizational resilient behavior and positively influence SC resilience, but without considering their impacts on organizational or SC performance. For instance, Rubbio et al. (2020) and Rubbio and Bruccoleri (2023) asserted that patient specific knowledge absorptive capacity is an enabler of these core dynamic capabilities. Loureiro et al. (2023) revealed hidden capacities that emerged when resource management challenges arose, suggesting that knowledge improves innovation capacity. Other research explained superior performance achieved in organizations or SCs using dynamic capabilities theory. Organizational performance is evaluated through metrics such as medical treatment effectiveness, physician compliance, operational efficiency, financial costs, and patient satisfaction, while SC performance is assessed by its environmental, social, and economic impact across the product life cycle. For instance, Junaid et al. (2023) proved that enhanced SC resilience improves SC performance, while Murphy and Wilson (2021) showed that system-wide dynamic capabilities lead to superior organizational performance at hospitals.

Dynamic capabilities reconfigure the resource base in an organization (Teece, 2007), and the reconfiguration may finally cause a change in performance. Therefore, dynamic capabilities explain changes in performance rather than overall performance. A main body of past research, as reported in Table 1, aimed to show that dynamic capabilities affect firm performance directly (Sermontyte-Baniule et al., 2022; Junaid et al., 2023, Murphy and Wilson, 2021), but this conflicts with the essence of dynamic capability theory (Laaksonen & Peltoniemi, 2018). Ordinary capabilities enable operational effectiveness, whereas dynamic capabilities create and seize opportunities through modifying ordinary capabilities, in turn affecting performance.

Although previous literature has demonstrated the connections between disruptions, dynamic capabilities, and competitive performance, the effectiveness of specific dynamic capabilities employed remains unclear. This dilemma underpins the first research gap.

> Research gap 1: Dynamic capabilities should be evaluated through the changes that they effect in performance before and after disruptions to an external environment.

This study examines PCS resilience capability as a dynamic capability within the framework of sensing, seizing and reconfiguration. Evaluation of PCS resilience capability is conducted through the changes in PCS' resources and resultant changes in performance. Changes in PCS performance were reflected by patients based on their own experiences of accessing medical services before and during the COVID-19 outbreak.

2.2. Healthcare operational resilience capability

Healthcare organizations are service-oriented, distinguished from manufacturers by their core mission of saving lives and their strong emphasis on the effectiveness of service provision (rather than efficiency). At the organizational level, there has been a large body of literature defining the concept of healthcare resilience, constructing a framework for healthcare risk management (Vishwakarma, 2023), or identifying practical strategies for building resilient health systems (Forsgren et al., 2022). At the SC level, Mandal (2017) applies dynamic capability theory to examine relationships among SC dynamic capabilities, buyer–supplier collaborations, and hospital performance. Junaid et al. (2023) verify that SC dynamic capabilities influence SC integration, SC resilience, and ultimately sustainable performance positively. Table 2 summarizes recent literature about healthcare system resilience in response to a specific disruption, the COVID-19 pandemic, under four categories: resilience capability attributes, context, research methods, and type of research work. The specific attributes that enable healthcare systems to adapt to disruptions are examined to define the core elements of resilience and address research question (2). Understanding the context where resilience is applied is essential for interpreting the effectiveness and applicability of dynamic capabilities. Additionally, examining research methods and classifying the type of research provide insights into the depth of the evidence supporting resilience capabilities and the robustness and validity of the findings. Literature review in Tables 1 and 2 informs the definition of ORC constructs and items for this study.

As demonstrated by Table 2, one stream of research tested the relationships between the resilience of healthcare systems and their attributes empirically, with attributes identified as big data analytics and improving innovation (Bag et al., 2021); agility, collaboration, flexibility, redundancy, and robustness (Scala & Lindsay, 2021); bridging and buffering (Spieske et al., 2022); and digitalization and industry 4.0 (Tortorella et al., 2023). The second stream of research applied mathematical modeling to facilitate decision making and enhance healthcare system resilience against disruptions caused by the pandemic (Hossain et al., 2021; Lozano-Diez et al., 2020). The third stream of research was grounded in literature review (Alemsan et al., 2022; Armani et al., 2020; Golan et al., 2021). Two more research gaps relating to healthcare resilience were identified as.

> Research gap 2: Additional studies with empirical design and strong theoretical foundation are needed to verify the generalizability of the findings related to healthcare operational resilience.
> Research gap 3: Studies using qualitative methods or mixed methodology are encouraged to draw from theories and to provide an in-depth analysis of healthcare resilience (Vishwakarma, 2023).

2.3. Resilience capability of primary care services in the United Kingdom and their attributes

One group of researchers construct resilience as a dynamic capability (Ali et al., 2022; Mandal, 2017), while the other group view resilience as a result of dynamic capabilities (Queiroz et al., 2021; Ruel & El Baz, 2021). In this study, the ORC of PCS is defined and assessed as a dynamic capability, emphasizing that resilience is not just a static outcome but an ongoing, proactive process that enables an organization to reconfigure resources and processes in response to changing environment.

Multi-echelon PCS were studied in this research, comprising patients, GP surgeries, and community pharmacies, as shown in Fig. 1. Services provided by dentists and opticians were not considered. The resilience of the PCS hinges on individual organizational operational activities at GP surgeries and community pharmacies, and how they reconfigure their resource base to control disruptions. During the COVID-19 pandemic, GPs reported successful adaptation to digital remote consultations (Li et al., 2022), which facilitated greater

Table 2
A literature review of healthcare operational resilience capability in response to COVID-19.

Literature	Attributes of resilience capabilities	Context	Research methods	Theoretical/ empirical
Alemsan et al. (2022)	Lean practices across the SC, complementary approaches to lean implementation	General healthcare SC (product and service)	Literature review	Theoretical
Armani et al. (2020)	Technology solutions, reverse engineering, maker community	Medical equipment production (product)	Literature review	Theoretical
Bag et al. (2021)	SC innovation, SC responsiveness	Pharmaceutical SC in South Africa (product)	Survey, structural equation modeling, thematic analysis	Empirical
Friday et al. (2021)	Risk information sharing, risk and benefit sharing, joint decision making, process integration, standardization of procedures, collaborative performance systems	Healthcare inventory management (product)	Literature review	Theoretical
Golan et al. (2021)	Resilience analytics, quantifying efficiency–resilience trade-offs	Vaccine SC (product)	Literature review	Theoretical
Hossain et al. (2021)	Governmental intervention, coordination, collaborative IT platform, healthcare infrastructure, dynamic workforce, flexible operations, quick response, etc.	General healthcare SC (product and service)	Total interpretive structural modeling, cross-impact matrix multiplication analysis	Empirical
Jafarnejad et al. (2019)	Agility, collaboration, information sharing, trust among actors, adaptability, structure, funding, etc.	Medical equipment SC (product)	Delphi method, system dynamics	Empirical
Lozano-Diez et al. (2020)	N/a	Pharmaceutical production (product)	Mixed integer linear model	Theoretical
Scala and Lindsay (2021)	Agility, collaboration, flexibility, redundancy	PPE healthcare SC in the United Kingdom (product)	Case study	Empirical
Spieske et al. (2022)	Bridging (supporting suppliers, long-term buyer–supplier relationships, enhanced visibility), buffering (extended upstream procurement, resource sharing)	Medical supplies SC in Germany, Switzerland and Austria (product)	Case study	Empirical
Tortorella et al. (2023)	Digitalization, industry 4.0	A hospital in Brazil (product and service)	Case study	Empirical
This research	Agility, flexibility, redundancy	Primary care services (service)	Survey and literature review	Empirical

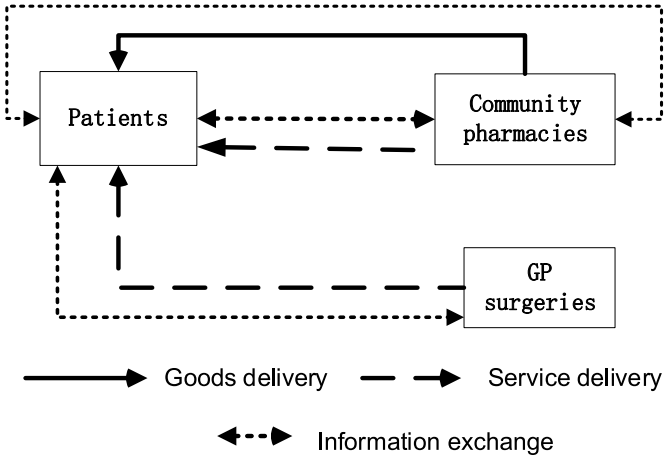

Fig. 1. Key stakeholders in PCS.

responsiveness and the creation and delivery of an "adapted" service. Telemedicine also became highly prevalent during the COVID-19 lockdowns, and retention of telemedicine services after 2022 was favored (OECD, 2023a). The rapid adoption of technology in community pharmacies was found to be pivotal in maintaining service continuity. However, little was understood about how these initiatives and innovations were being implemented and their impact on patients. Despite greater usage of these solutions and high-level acceptability by healthcare providers, concerns have been raised about the cost effectiveness of telemedicine solutions (Jacob et al., 2024) and their impact on equity and efficiency implications (OECD, 2023a). More data are also needed to fully understand their impact on health system performance accurately (OECD, 2023b).

3. Research methodology

This study uses both qualitative and quantitative methods. The qualitative research was conducted in two phases: (1) a literature review to conceptualize and operationalize the construct ORC by exploring the underlying attributes and (2) a review of healthcare literature to identify the key attributes specific to ORC in PCS in the United Kingdom, with a focus on GP practices and pharmacies. Findings from phase (2), namely the evidence of ORC in PCS, were utilized to design a questionnaire to gather patient evaluations of changes in accessing PCS before and during lockdown. Patients were asked to recall their experiences of accessing PCS before lockdown when completing the questionnaire. This was not a longitudinal study. Fig. 2 illustrates the research design, including literature review, a questionnaire survey, and subsequent statistical and content analysis of this information. To address the two research questions, a χ^2 test was performed on responses to the structured questions to identify whether there had been any significant changes before and during the lockdown in accessing healthcare services. Content analysis was performed on responses to the open-ended questions to gain deep insight into the underlying factors that may result in different patients' views and opinions, which informs our recommendations on the specific dynamic capabilities that NHS need to invest in and develop.

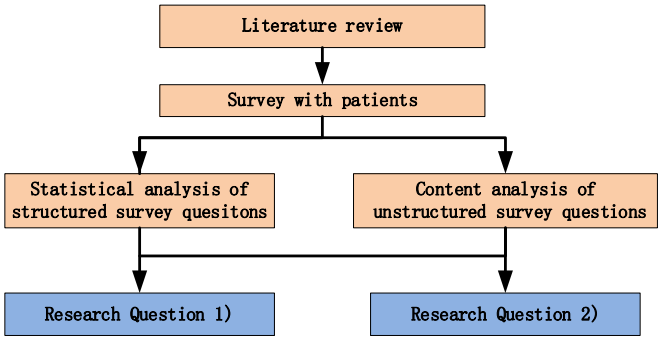

Fig. 2. Research design.

3.1. Conceptualization of operations resilience capability

An extant literature review shows that SC resilience capability or ORC is a multidimensional construct that can be measured on multiple dimensions (Ali et al., 2017; Ambulkar et al., 2015). To develop the scale for PCS ORC, we extracted a pool of items from literature for each ORC dimension created and validated in the literature. The items most relevant to healthcare operations and this study were selected. Conceptualization of ORC can be approached from various angles. Some studies emphasize proactive aspects of resilience, while other consider proactive, concurrent, and reactive capabilities (Choudwary and Quaddus, 2017; Ali et al., 2017). In the pre-disruption phase, proactive strategies relate to competencies required during the pre-disruption phase; in the context of during-disruption phase, concurrent strategies consist of rapid changes of the system during disruption; in the post-disruption phase, reactive strategies take place after the disruption (Ali et al., 2017). Ali et al. (2017) identified 13 essential constructs that support firms in aligning with proactive, concurrent, and reactive strategies and in developing SC resilience capabilities. The 13 constructs are: situation awareness, robustness, increasing visibility, building security, knowledge management under the proactive strategy; increasing flexibility, building redundancy, collaboration, and agility under the concurrent strategy; and contingency planning, market position, knowledge management and building social capital under the reactive strategy. In most SC resilience literature, concurrent strategies are classified under reactive strategies. For instance, according to Vugrin et al. (2011), proactive capabilities encompass flexibility, redundancy, integration, financial strength, and market capability, while reactive capabilities include agility, response efforts, and recovery time. Since the research was conducted in the context of the during-disruption phase (at the beginning of the COVID-19 outbreak), concurrent strategies and associated capabilities are relevant to this study.

From a dynamic capability perspective, a process of dynamic capability building involves sensing opportunities and threats, seizing opportunities, and reconfiguring organizational resources (Teece, 2007). Since the research was conducted when disruptions had already been caused, we did not investigate proactive features of PCS and associated abilities related to sensing opportunities, but focused on its concurrent ability to seize opportunities and reconfigure resources in line with environmental changes (Choudwary and Quaddus, 2017).

(1) The PCS *seize opportunities* to respond to the pandemic efficiently and adequately. This capability building requires PCS to have the ability to make quick and adequate response, that is, *agility* (Scholten & Schilder, 2015). To respond to disruptions, it also requires PCS to develop *collaborations* with partners through collaborative planning, information sharing, and integration (Ali et al., 2017)
(2) The PCS *reconfigure resources* to achieve desirable outcomes and mitigate the impacts of disruptions. Developing this capability requires the PCS to enhance their adaptability by increasing *flexibility* for rapid adjustments and building *redundancy* to handle sudden changes through the strategic use of excess capacity (Ali et al., 2017).

The above screening process led to four constructs to be considered in this research: agility, collaboration, flexibility, and redundancy.

3.2. Scale development

The next step is to develop a multi-item scale to measure each construct. Pre-established items were carefully selected for each scale. The assessment of SC (or operational) resilience capability typically relies on metrics such as organizational and employee performance, along with financial data (Laaksonen & Peltoniemi, 2018). However, Furnival et al. (2019) identify sensing customer needs as an important dynamic capability, emphasizing the importance of addressing patient concerns and expectations for resource reconfiguration and process improvements. In contrast to conventional measurement methods, this research extends its data collection by evaluating the effectiveness of PCS operational resilience through patient assessments of their experiences in accessing PCS.

The items most relevant to PCS operational context were selected, subject to meeting three criteria: (1) the scale validity and reliability have been verified in previous studies; (2) the items are relevant to and suitable for the context PCS considered in this research; and (3) patients have access to supporting evidence regarding these capability attributes and ability of judging these capabilities.

Regarding criterion (1), a comprehensive list of underlying attributes related to the four constructs have been identified and validated by Choudwary and Quaddus (2017) and Ali et al. (2017). The concurrent ability and its associated attributes encompass *ability to respond* and *ability to adapt*. Under ability to respond, the two capability attributes are agility and collaboration, while increasing flexibility and building redundancy are operationalized under ability to adapt. After duplicated items were removed, a list of 19 items were extracted and are shown in Column C in Table 3. Concerning criterion (2), the list of items in Column C in Table 3 were compared with the resilience or dynamic capabilities attributes in Tables 1 and 2 to extract the underlying attributes defining ORC of healthcare operations. Regarding criterion (3), this study does not examine capabilities associated with partner integration, financial strength, cost, or organizational growth, given that measuring such capabilities requires longitudinal data to capture the evolutionary paths of organizational capability changes. When screening attributes against criteria (2) and (3), we followed the method used by Ambulkar et al. (2015) to calculate degree of relevance for criterion (2) and degree of accessibility for criterion (3) (see the supplementary file). This process resulted in a scale reduced to 9 items.

As shown in Table 3, measurement items under collaboration include collaborative planning, SC intelligence, information sharing, coordination and cooperation with competitors. In the context of PCS, these practices are related to collaboration between GPs and pharmacies and their fellow entities, competitors, or suppliers. Patients do not have access to information regarding these collaborations; hence these items were not included as measurement scales. A few items under redundancy were also removed for the same reason. Furthermore, several items under flexibility were excluded, as they were not relevant to the PCS. The two items under the construct coordination, namely coordination and cooperation with competitors, were merged into the redundancy construct, as they relate to bridging activities that build redundancies.

After screening and merging, we selected nine items to construct the resilience framework for PCS, as illustrated in Fig. 3: two items to measure *agility*, healthcare organizations' *quick and adequate responses*; two items to measure *flexibility*, the ability to reconfigure internal resources and structures quickly and efficiently to adapt to changes, measured as *multiple supplies and new products/services*; and five items for *redundancy*, including the two items transferred from the coordination construct. *Building redundancy* is achieved by building up excess capacity in production or supplies through buffering and bridging strategies (Spieske et al., 2022). In traditional product SCs, *buffering strategies* include the application of lean tools and postponement, building slack resources, seeking alternative suppliers, limiting capacity utilization and multiple modes of transportation (Manhart et al., 2020). *Bridging strategies* reduce uncertainty through cross boundary activities, such as coordination with suppliers and patients, and cooperation with competitors (Datta, 2017).

3.3. Questionnaire design

Before the questionnaire was designed, an extensive review of healthcare-related literature was conducted to identify operational practices corresponding to the construct items presented in Fig. 3, to design questions for assessing PCS ORC from patients' perspectives. In

Table 3
Scale development.

A. Resilience capability	B. Resilience capability constructs	C. Items	D. Inclusion (Y/N)	E. Rationale for exclusion	F. Selected items
Ability to respond	Agility	1. Quick response	Y		Quick response
		2. Adequate response	Y		Adequate response
	Collaboration	3. Collaborative planning	N	Not meeting criterion (3)	
		4. SC intelligence	N	Not meeting criterion (3)	
		5. Information sharing	N	Not meeting criterion (3)	
		6. Coordination with suppliers and customers	Y		Bridging medical resources
		7. Cooperation with competitors	Y		
Ability to adapt	Flexibility	8. Flexible supply via multiple suppliers	Y		Flexible supply via multiple suppliers
		9. Flexible manufacturing processes or sources	N	Not meeting criterion (2)	
		10. Flexible order fulfilment	N	Not meeting criterion (2)	
		11. Flexible pricing via responsive pricing	N	Not meeting criterion (2)	New products or services
		12. Flexible transportation mode	N	Not meeting criterion (2)	
		13. Flexible products or service	Y		
	Redundancy	14. Excessive capacity in production transportation, inventory, and storage (Ratick et al., 2008)	Y		Buffering medical resources
		15. Multiple suppliers	Y		
		16. Safety stock	N	Not meeting criterion (3)	
		17. Strategic inventory	N	Not meeting criterion (3)	
		18. Emergency backup/storage facilities	N	Not meeting criterion (3)	
		19. Limit capacity utilization	Y		Buffering medical resources

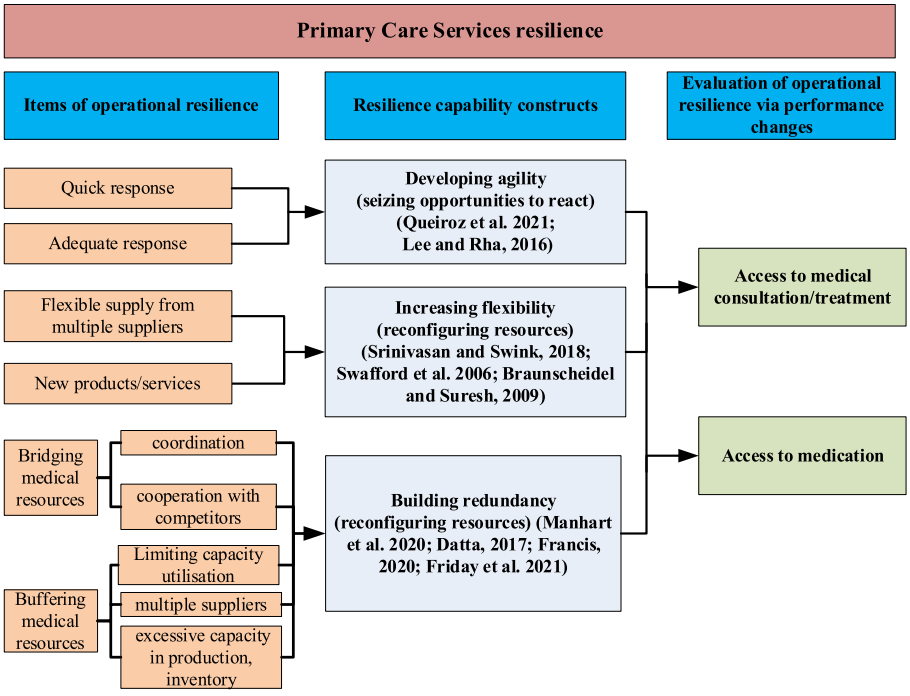

Fig. 3. The primary care service resilience framework.

addition to academic literature, a wide range of gray literature (policy and professional reports/documents) and media articles provided great insights into the impact of COVID-19 on healthcare provision. A list of 16 matching practices were elected to support the three ORC constructs and the associated nine measurement items, as presented in Column C in Table 7 in Section 4.1. Under the *agility* construct, after sensing threats and disruptions posed by COVID-19, the NHS, GP surgeries, and pharmacies needed to respond swiftly to address these disruptions (Pettit et al., 2013). Developing agility allows stakeholders in PCS to respond quickly to patients' demand quality and integrate with suppliers and

other stakeholders effectively (Lee & Rha, 2016). However, Murphy et al. (2021) reveal that these responses are inadequate in meeting patients' needs, as they prefer face-to-face medical consultation/treatment, and many patients experienced delays or a shortfall in receiving medicines, leading to a perception of lower quality in the adapted service. After seizing opportunities and performing quick responses, PCS needed to reconfigure resources to produce and supply a wide variety of products to different customer groups (Swafford et al., 2006). From patients' perspectives, healthcare organizations' *flexibility* is reflected as a flexible production/supply volume of healthcare services and medical products (Braunscheidel & Suresh, 2009); product/service availability, variety and customization (Braunscheidel & Suresh, 2009); distribution flexibility; and introducing new products/services (Swafford et al., 2006). Building *redundancies* in PCS was achieved by buffering slack medical resources, such as introducing additional supplies of medical consultations or prescriptions (Aldrighetti et al., 2019), increasing safety stocks at pharmacies, restricting demand or limiting service hours, or increasing medical workforce reserve available to support any future surges in demand (NHS England, 2024). Redundancy was also created by bridging measures within the healthcare supply base, such as medical organizations coordinating resources, joint planning and decision making, and reducing services (Friday et al., 2021). Patients assess redundancy in terms of their access to multiple medical supplies, access to shared resources (such as being referred to a different GP or pharmacy), and the impacts of constrained medical services.

Based on the list of operational PCS practices claimed in the literature in response to the pandemic, a questionnaire was developed to assess patients' perspectives on and experiences of accessing the adapted service. The questionnaire had 25 questions, taking the form of both closed- and open-ended questions (see a copy of the questionnaire in the supplementary file). It is important to emphasize that dynamic capabilities explain changes in performance; hence, the principle guiding the questionnaire design is evaluating changes in the healthcare service provided to patients. Referring to the 16 PCS operational practices presented in Table 7 in Section 4.1, several closed form questions were designed to assess these practices and compare them with the healthcare service received before the lockdown period. Since patients cannot judge directly if collaborations were formed among competitors, reflective measurement questions such as Questions 8 and 21 were constructed to assess if patients were referred to services offered by alternative GP surgeries or pharmacies. The closed form questions included binary scale, nominal scale, ordinal (Likert) scale, and matrix questions in relation to (a) access to medical consultation/treatment during lockdown; (b) ordering and collection of prescription medicines before and during lockdown; and (c) demographic information about respondents. Considering that official statistics were published before the pandemic on the waiting time (speed and dependability) and mode (flexibility) of medical consultation, questions were only designed to assess patients' experiences of accessing medical consultation during the lockdown period; for instance, Questions 10 and 11 were constructed to compare the changes in the speed and mode of service delivery. However, at the time of this research, there were very limited official statistics published about medicine ordering and collection at pharmacies, which led to the introduction of Questions 17–20 to compare the experiences of ordering and collecting medicines from pharmacies. Reflecting on the literature evidence on inadequate responses from both GP surgeries and pharmacies, Question 23 was introduced to assess the delays and availability issues experienced in receiving medicines.

Closed questions are useful to capture information regarding changes in people's access to these services in terms of speed, flexibility, and dependability, but evaluations of changes could vary significantly with individuals. We are interested in individualized experiences, opinions, assessments, and the rationale behind that. Therefore, open questions were designed to assess this element, which also allow individuals to share their views or plans for future access to PCS. A survey was conducted through the administration of an electronic questionnaire to the public in the United Kingdom, but only responses from existing patients (users actively receiving medication/treatment or accessed pharmacy services) were retained and analyzed.

3.4. Data collection and sampling characteristics

To test the validity of the survey questions and the intended purpose of this data collection method, the questionnaire was piloted with 16 academics in three UK higher education institutions and 8 non-academics from a variety of different backgrounds. In taking this step, we employed an adapted cognitive interview, wherein we asked participants to review the survey instrument regarding its structure, readability, ambiguity, and completeness, which led to several revisions. The stability of survey and their ability to be understood by participants over a period of time were considered. Given that the pandemic status had no defined end date, we did not feel that the reliability of the survey would be problematic.

The finalized survey was distributed via email, business communication platforms (including Zoom and MS Teams), and digital social media platforms (including WhatsApp, Facebook, WeChat, and LinkedIn), in the United Kingdom's first lockdown period (March–June 2020). A semi-structured questionnaire, along with a cover letter, was distributed to the public, explaining the aim and methodologies of the research. An online survey was chosen because research has shown that data collection through the Internet can match high-quality traditional research routes (Angrisani et al., 2019) and this was the only viable way to collect data during the lockdown period. Online surveys have the advantages of low cost and ease of administration, but a major disadvantage lies in their limited capacity to derive a scientific sample of the broader population. Surveys were distributed to the public in the United Kingdom between 1 and June 28, 2020 using convenience sampling, resulting in 307 complete and valid responses received from wide geographic areas in the United Kingdom. No exact sample size was planned, though time limitations were imposed on the survey to ensure that responses related to the same lockdown period to minimize the effects of the rapidly changing conditions caused by the pandemic (Lakens, 2022); thus, as large a sample as could be obtained was used. Among the 307 responses, 134 respondents needed access to medical consultation/treatment during the lockdown period, and they are defined as Group 1; 145 respondents needed to order prescription medicines during the lockdown period, and they are categorized as Group 2. Across both groups, 96 respondents needed to access both consultation and medication, and in total there were 183 actual patients whose responses were retained and analyzed.

The demographic information from the respondents in both groups is comparable with the 2011 UK Census outputs (see Table 4), although it is skewed toward individuals with a higher level of education. Moreover, the 75+ age group is absent in the survey demographic, likely due to the electronic nature of the survey. However, given that an online survey was the only viable way to collect data during the lockdown period, the use of convenience sampling was deemed appropriate to gain initial primary data regarding PCS resilience capabilities during that time.

3.5. Sample selection bias and non-response bias

An analysis of the samples from Group 1 and Group 2 suggested that age groups from 35 to 64, females, individuals with higher education levels, and employed workers were overrepresented in the samples compared with the 2011 UK census data. A two-sample Kolmogorov–Smirnov (KS) test was conducted to compare the equality of probability distributions of the samples with the UK Census population. The KS results in Table 4 indicate that the samples were drawn from the same distribution as the UK Census population.

To further examine sample selection bias, bivariate statistical methods were used to compare the demographic profiles of participants

Table 4
Demographics of questionnaire respondents.

Age	%	Gender	%	Education	%	Employment	%
18–24	3.7%	Male	25.4%	No formal qualifications	0%	Full-time	62.0%
	2.8% (10.1%)		*25.5%* (49.1%)		*0%* (22.7%)		*58%* (48.0%)
25–34	17.9%	Female	74.6%	Levels 1 & 2 (secondary)	6.0%	Part-time	21.6%
	11.7% (16.7%)		*74.5%* (50.9%)		*11.1%* (13.3%)		*23.5%* (13.7%)
35–44	30.6%			Level 3 (sixth form)	16.4%	Unemployed	3.7%
	26.2% (17.5%)				*17.2%* (27.6%)		*3.4%* (8.9%)
45–54	24.6%			Level 4 (higher degree)	77.6%	Student	6.0%
	24.8% (17.3%)				*71.7%* (27.2%)		*5.5%* (9.3%)
55–64	18.7%			Other	0%	Retired	3.7%
	24.1% (14.7%)				0% (9.3%)		*6.9%* (13.9%)
65–74	4.5%					Other	3.0%
	9.7% (10.9%)						*2.7%* (6.2%)
75+	0%						
	0.7% (9.7%)						
MW test statistic[a]	−0.37	−0.43		1.05		1.04	
	−0.06	*−0.43*		*0.84*		*0.85*	
p-value	0.71	1.33		0.30		0.30	
	0.95	*1.33*		*0.40*		*0.40*	
KS test statistic[b]	0.57	0.50		0.58		0.67	
	0.43	*0.50*		*0.42*		*0.51*	
p-value	0.21	1.00		0.33		0.14	
	0.54	*1.00*		*0.82*		*0.47*	

Note: Group 1 statistics are in non-italic numbers, group 2 statistics are in italic numbers, and the 2011 UK Census is shown in brackets.
***<0.001, **<0.01, *<0.05.
[a] Mann–Whitney test.
[b] Kolmogorov–Smirnov test.

and the UK Census population, a method widely used in social work research. In this study, a Mann–Whitney test was used to determine whether there was a systematic difference in gender, age, educational level, and employment status (see Table 4). At a significance level of $\alpha = 0.05$, the Mann–Whitney test results indicated that there was no evidence showing that the samples and the UK Census population were not equal regarding gender, age, educational level, and employment status.

The above statistical results show that the two samples resemble the demographic distributions of the UK Census population and are representatives of the UK population. We treat each group as an individual cohort, and we are interested in their collective opinions on the adapted medical service rather than in how demographic variables influence their opinions. Hence, the impacts of demographic characteristics on the responses were not investigated in this research.

Non-response bias is indicated when there is significant variation between the early and late responses received for a survey. For the samples in Groups 1 and 2, the responses received before June 10, 2022 were classified as early responses (46 in Group 1 and 57 in Group 2), and the responses received on or after 10 June were regarded as late responses (88 in Groups 1 and 2). A *t*-test was calculated for the means of the early and late responses, and the results suggest there is no significant variance between the two sets of responses; thus, nonresponse bias was not detected in the samples.

3.6. Statistical analysis

Since this study compares differences in PCS operational performances before and during the pandemic lockdown period, χ^2 analysis was conducted to compare various metrics of medical consultation/treatment and pharmacy service, such as waiting time for consultation appointment, the mode of consultation appointment, and the mode of ordering and collecting medication before and during lockdown period. Those questions answered using a binary scale were analyzed using descriptive statistics-for example, the percentage of respondents knowing or having used the healthcare apps, or the successful referral rate to alternative GPs or pharmacies. Structural equation modeling was not performed, as this study does not model complex relationships between ORC and its antecedents and consequents, but merely analyzes the evidence of dynamic capabilities of PCS and the resultant changes in healthcare service provision.

3.7. Content analysis

The objective of content analysis is to transform open-ended survey responses systematically and objectively into meaningful, concise summaries of key themes. Theme development is a step-by-step process of abstraction of data from the manifest and literal content to latent meanings. The open-ended questions were designed to explore (i) why participants did/did not prefer the change in their access to treatment/consultation and (ii) experiences of accessing medical services during the lockdown period. Responses from the 183 patients on the open questions Q14 and Q25 were analyzed.

Table 5 shows the details of each question. Iterative steps were undertaken to describe and categorize the meaning in each response concisely and to identify connections between responses. Two co-authors undertook the manual coding separately. Ambiguous responses were not coded. A subset of 20 responses were iteratively coded by two co-authors to establish coding agreement based on their outcomes, who engaged in dialogue to reconcile differences. The two co-authors continued to finish coding the rest responses following these steps.

Step 1. Responses to each question were classified as positive and negative. For example, among the 44 responses to Q14, 11 responses were classified as negative and 33 as positive.
Step 2. Through manual reviewing, coding, adjusting, and recording the respondents' data, subordinate themes (sub-themes) were isolated from the responses to each question. The 33 positive responses to Q14 were further classified into eight themes, coded as A–H in Table 6.
Step 3. Related sub-themes were assigned distinct codes and then merged into superordinate themes (sup-themes) for Q14 and Q25, respectively. For instance, the eight sub-themes under the Positive category for Q14 were merged into two higher level sup-themes, namely *service access* and *impacts on patients*. These merged sub-themes were subsequently organized into a higher level and categorized into themes for access to consultation/treatment service and access to pharmacy service.

Table 5
Details of open-ended questions.

Question No.	Question	Number of responses	Categories	Number of sup-themes[a]	Number of sub-themes[b]
14	If you accessed consultation/ treatment in a different way, please explain why you did/ did not prefer this to how you did so previously.	44	Access to consultation service	6	20
25	Please provide any further comments or experience you have had relating to the use and access of non-emergency healthcare services during lockdown. This may relate to consultations, treatment, and prescriptions.	70	Access to pharmacy service	4	10

[a] Superordinate themes (sup-themes) are clear topics that are dominant in the study and are a result of the convergence of two or more sub-themes.
[b] Subordinate themes (sub-themes) are emerging areas of interest from the content/context based on raw data scrutiny.

4. Research findings

The key findings from statistical analysis and content analysis are summarized in this section. Referring to research framework in Fig. 2, we map the adaptation in the two areas of service, access to medical consultation/treatment and pharmacy service, against agility, flexibility, and redundancy. The findings presented in Table 7 demonstrate how the key themes and statistical results in Column E serve as evidence of dynamic capabilities, corresponding to operational practices in Column C. This, in turn, validates the resilience capability constructs in Column A and items in Column B.

4.1. Access to adapted medical service

Agility: The statistical results and content analysis in Column E of Table 7 show that the NHS was able to reshape primary care delivery quickly, introducing remote consultation systems (theme code CPA; Greenhalgh et al., 2020), and online pharmacy and prescription (theme code PPA; Verma & Gustafsson, 2020), validating its quick response in C1 and C2. Although both groups felt that the adapted medical service was quick, they regarded the adaptations as inadequate in meeting their needs due to delays (C4) or shortages (C5) in receiving medicines (supported by theme codes PND and PNE) and expressed a preference for face-to-face consultation (C3; evidenced in theme code CNA). Inadequate response was attributed to communication difficulties, online system failures (theme code CNH), and perception of lower quality of service (theme code PNA).

Flexibility: The NHS 111 telephone service was expanded as a first point of contact if patients developed COVID-19 symptoms; it served patients well initially but failed to manage the overwhelming number of calls after the pandemic outbreak (Green, 2020). In Fig. 4, the appointment modes and waiting times within the same period in 2019 (NHS Digital, 2019), March to June 2019, are compared with the appointment modes and waiting times in March to June 2020. The COVID-19 pandemic rapidly shifted GP services into a new model of telephone assessment and remote consultation. The χ^2 test ($\chi^2_{(2)} = 81.72$, $p < 0.05$) shows that there was a significant change in the appointment mode during the lockdown, resulting in a dramatic shift from face-to-face to telephone consultations. The waiting times during the lockdown were similar to the waiting times before the lockdown, as evidenced in Fig. 4 (c and d) and the χ^2 test ($\chi^2_{(4)} = 0.60, p > 0.05$). The χ^2 tests and the theme CPA presented in Column E in Table 7 demonstrate the distribution of a diverse range of consultation services and a flexible service portfolio to patients through multiple channels, supporting evidence outlined in C6.

Pharmacies also introduced multiple ways of ordering and collecting medicine, including online prescription, home delivery to patients, prescription-ordering apps, and drive-through pharmacy services (Hussain & Dawoud, 2021). This flexibility was verified in the theme codes PPA and PPB and the χ^2 analysis. The χ^2 results showed that there was a significant decrease in the use of GP surgeries (when attending appointments; $\chi^2_{(1)} = 48.39$, $p < 0.05$) and community pharmacies ($\chi^2_{(1)} = 17.05, p < 0.05$), but an increment in online ordering ($\chi^2_{(1)} = 6.13, p < 0.05$) as the primary ordering methods during the lockdown period. Collecting medicine from community pharmacies remained the main method. These results support evidence in C7 and validate the introduction of a flexible pharmacy service portfolio.

Furthermore, a larger number of mobile apps were implemented to have a timely effect for contact tracing, information provision, diagnostic purposes (Chidambaram et al., 2020), or prescription apps, but the awareness and use of these apps remained very low. Although the apps were highly rated (rated as 7.5 out of 10), supporting the evidence in C8, there was very little use of prescription apps. Respondents highlighted challenges in integrating apps with GP consultations and prescriptions.

Redundancy: Regarding the ability to bridge medical resources, GP surgeries and pharmacies tried to develop collaborations and share resources at a district or city level to concentrate COVID-19 care (Garfield et al., 2021; van Weert, 2020), but the survey results show that only 39% were referred to a different GP service, which does not fully support the ability claimed in C9. The claim in C10 was not supported either, as excess capacity for consultation was not available in locations where there was a surge in demand, nor were additional GPs sourced or deployed from places where there were lower demands to share the excessive workload (Green, 2020), as reflected in theme PNA. Similarly, only 26% of patients were referred to a different pharmacy and 32% experienced delays in receiving medicines, which does not validate resource sharing among pharmacies in C11. To limit capacity utilization and generate capacity slack, restrictions were placed on GP surgeries seeing acute patients without COVID-19 symptoms (Iyengar et al., 2020); routine medical checks and home visits were reduced (theme code CNK; Verhoeven et al., 2020); and only 16.1% of appointments were conducted face to face during the lockdown period. Furthermore, pharmacies adjusted their opening hours (theme code PNA) and imposed limits on medication orders to prevent stockpiling and to build up safety stock levels (Cadogan & Hughes, 2021). These findings serve as evidence of capacity limitation in C12–14.

Regarding the capability to buffer medical resources, the UK government's call for healthcare volunteers achieved an excellent response, but volunteers were more helpful in supporting social care than expanding medical care capacity (Comas-Herrera et al., 2020). The recruitment through graduate scheme was helpful in growing support for the medical team, rather than growing the capacity of the frontline medical service, as revealed in theme code CNL. Patients still experienced delays in receiving medicine, even though pharmacy graduates were deployed to support the pharmacy workforce (Choi et al., 2020), as evidenced in theme codes PNB and PND. Patients felt that there were more resources for medicine delivery, but there was not enough capacity

Table 6
Theme development in content analysis.

	Data sorting	Sup-theme	Sub-theme	Iterations	Codes
Access to **C**onsultation/treatment service (Q14)	**P**ositive	Service access	A. Multiple channels of remote access (phone, online, video, email and apps) were introduced quickly.	65	CPA[a]
		Impacts on patients	B. Saved time for patients	9	CPB
			C. Quicker response from service	8	CPC
			D. Greater flexibility of access to service for patients	2	CPD
			E. Remote service offers greater convenience for patients	6	CPE
			F. Greater efficiency	14	CPF
			G. Better access via remote technology	*26*	*CPG*
			H. Satisfied with remote access	*33*	*CPH*
	Negative	Face to face preference	A. Clinical assessment needs to be face to face	17	CNA
			B. Inferior service when compared with Face to Face	5	CNB
			C. Less confidence in quality of remote treatment	6	CNC
		Service complexity	*D. Worried about engagements with remote services*	*5*	*CND*
			E. Changes will lead to service delays and potential failures	*3*	*CNE*
			F. Remote services require technical knowledge and digital literacy	*6*	*CNF*
			G. Remote services can cause issues if patients have difficulty in communication.	4	CNG
		System failures	H. Service cancellations or referred services not materializing	4	CNH
			I. Access to remote system was challenging	*4*	*CNI*
			J. Not confident in security of online provision	*4*	*CNJ*
		Reduced treatment capacity	K. Reduced routine medical checks and home visits	4	CNK
			L. Inadequate GP treatment	3	CNL
Access to **P**harmacy service (Q25)	**Data Sorting**	**Sup-themes**	**Sub-themes**	**Iterations**	**Codes**
	Positive	Service access	A. Electronic medicine prescriptions and doorstep delivery (phone, online, and apps) were introduced swiftly.	6	PPA[b]
		Impacts on patients	B. Greater flexibility of access to medicines.	5	PPB
			C. Saved time for patients.	4	PPC
			D. Quicker response from service	6	PPD
	Negative	Limited pharmacy access	A. Reduced pharmacy service hours and restricted number of visitors	8	PNA
		Impacts on patients	B. Referral to other pharmacies not materializing	4	PNB
			C. Delays in medicine dispensing	8	PNC
			D. Delays in receiving medicines	6	PND
			E. Medicine shortage	*5*	*PNE*
			F. Downgraded pharmacy service	*4*	*PNF*

[a] CPA represents theme **A**n under the **P**ositive category of access to **C**onsultation/treatment service.
[b] PPA represents theme **A**n under the **P**ositive category of **P**harmacy service.

in dispensing medicine or serving patients in pharmacies, as reflected in theme PNC. These results indicate inadequate development in buffering medical resource, as reported in C15–C16.

The themes identified from the content analysis offer robust evidence for the resilience capabilities of agility and flexibility and their associated sub-attributes. However, there is inadequate evidence, particularly regarding resource sharing, collaborations, and additional sourcing and supplies, to support the redundancy aspect. Several new themes emerged from the content analysis, but they are not included in Table 7 as evidence for the dynamic capabilities of the adapted medical service. These themes, including CPG and CPH, reflect patients' content with remote services, alongside concerns on engagement, potential failures, security, and the need for technical literacy with remote service usage (CND-CNF). In addition, PNF-downgraded pharmacy service was also reported by patients. The combined insights from content analysis and statistical analysis indicate that while the performance of the adapted remote service was deemed successful, there was no strong preference for it. The speed, convenience, and flexibility of medical service were the main factors driving the preference, while difficulty in communication, system failures, and perceptions of service quality were the main reasons for the face-to-face preference. The relevant quotations from patients (indicated in italics) provide more insights into the causes and implications of different opinions (see Table 7).

5. Discussion of findings

The dynamic capability view stipulates that resource accumulation, integration, redeployment, and reconfiguration are key elements in combatting challenges posed by rapid environmental changes (Teece, 2007). These key elements were evident in the PCS's dynamic capability building process, leading to the development of agility, flexibility, and redundancy in responding to the COVID-19 disruption. While providers claimed higher levels of resilience and agility in marshalling resources and adapting service delivery, patients' evaluations of the adapted service provision are different. Patients, as recipients of the adapted services, reported negative experiences with certain services that were claimed to be effective and efficient through central coordination (Majeed et al., 2020), such as the NHS 111 helpline and the awareness and use of healthcare apps. Prior studies assumed positive impacts of SC resilience upon performance (Ali et al., 2022) without using independent sources for SC resilience data and performance data (Laaksonen & Peltoniemi, 2018). In the context of the PCS, there could be a huge discrepancy in the evaluations made by healthcare providers and patients ofn the effectiveness of adapted services at this time. Understanding how specific dynamic capabilities affect service/product delivery to recipients would enhance resource allocation, leading to more effective mitigation and operational performances in the future.

5.1. Effectiveness of PCS resilience

To answer the first research question, patients' evaluation of PCS resilience in response to the COVID_19 pandemic, we examined the relationships between dynamic capabilities and changes in performances, using varied performance measures, multiple data sources, and indirect approaches (Baía & Ferreira, 2024). This approach helped to minimize the common method bias, or the halo effect, which credits superior

Table 7
Resilience capabilities mapping for adapted medical service.

A. Resilience capability construct	B. Items	C. PCS operational practices	D. Data collection and analysis	E. Evaluation of performance changes using theme codes, patient quotes (in italics) and statistical analysis
Agility	Quick response	1. Remote consultations/treatments were swiftly implemented as the United Kingdom entered lockdown (Greenhalgh et al., 2020). 2. Electronic prescriptions were rapidly introduced as the United Kingdom went into lockdown (Verma & Gustafsson, 2020).	Q6, 7, 11, and 25 Descriptive analysis of Q6, 7, and 11 Content analysis of Q25	CPA[a] *GP surgery and local pharmacy were quick, thorough and clear with the changes they needed to make*[b] PPA
	Adequate response	3. Patients and GPs preferred face-to-face medical consultation/treatment (Murphy et al., 2021).	Q14 content analysis	*Clinical assessment ideally requires physical contact with a practitioner, which a telephone-based assessment did not match up to.* CNA
		4. There was a delay in receiving medicine (Murphy et al., 2021).	Q23 descriptive analysis	26% of the 145 respondents in Group 2 experienced delays or availability issues in obtaining prescription medicine. PND
		5. There was a shortfall in supplying medicine (Murphy et al., 2021).	Q23 descriptive analysis	*My dedicated pharmacy did not have my anti-epilepsy medication and had to order it from the manufacturer.* PNE
Flexibility	Flexible supply via multiple suppliers	6. Patients could access medical consultation via multiple channels, including face-to-face, phone, online video call/chat, or a combination of these channels (NHS Digital, 2019).	Q11 χ^2 analysis Q14 content analysis	In Group 1, 56 booked appointments, 62.5% were conducted via phone, 8.9% via online video, 16.1% face-to-face, and 12.5% via a combination of these channels. *I use a lot more online Lloyds Pharmacy consultations. I think even once things are back to normal, for not very serious issues I will continue using online services offered by other suppliers, even if I have to pay a fee.* CPA χ^2 analysis indicates a significant shift in appointment modes during lockdown, while waiting times remained comparable to those before the lockdown.
		7. Multiple ways of ordering and collecting medicine were available, including attending GP appointments, electronic prescriptions, repeat prescription apps (Hussain & Dawoud, 2021), pharmacy delivery, NHS volunteer delivery, or collection from pharmacies (Well, 2020).	Q17-20 χ^2 analysis	There was a significant increase in the use of online prescription for ordering medicine (from 32% to 53%). The primary method for medicine collection remained unchanged, with 66% of the 145 respondents in Group 2 collecting medicines from pharmacies during the lockdown. χ^2 analysis reveals a notable decline in the utilization of GP surgeries (from 74% pre-COVID-19 to 33% during lockdown) and community pharmacies (from 49% pre-COVID-19 to 30% during lockdown) for medication ordering. PPA, PPB
	New products/ services	8. New apps were introduced to patients, such as NHS app, Patient Access, Doctor Link, and Surgery (Chidambaram et al., 2020).	Q12, 13, and 24 descriptive analysis	Awareness and use of these apps were low. Across the 134 Group 1 patients, 31% (42) were aware of medical consultation/treatment apps and 14% (19) used them. Among the 145 Group 2 respondents, only 13% (19) used the apps to order repeat prescriptions. CPA, PPA
Redundancy	*Bridging:* cooperation with competitors	9. GP surgeries developed collaborations and shared resources. Patients were referred to other surgeries if they could not obtain appointments with their own GP (van Weert, 2020).	Q8 and 9 descriptive analysis	Among the 28 respondents who were unable to book an appointment with a GP, 39% (11) were referred to a different GP and 61% (17) were not.
	B*ridging:* cooperation with competitors	10. Redeploying redundant resources from GPs and pharmacies where there were lower demands (Green, 2020).	Q15 and 25 descriptive analysis	Redundant resources were not deployed successfully, and the capacities at pharmacies and GPs remained stretched. PNA
	Bridging: coordination with suppliers and patients	11. Patients were referred to other pharmacies (including online) if they could not obtain medicine at local pharmacies (Garfield et al., 2021).	Q21–23 descriptive analysis	Among the 38 respondents who were referred to a different pharmacy (26% of all the respondents who need prescriptive medicines), 12 (32%) patients experienced delays in receiving medicine due to lack of visibility of inventory in other pharmacies. PNB, PND
	Buffering: limiting capacity use	12. Limits on face-to-face appointments were imposed (Iyengar et al., 2020; Murphy et al., 2021).	Q11 descriptive analysis	Only 16.1% of medical appointments were conducted face-to-face during the lockdown period, compared with 80% during the same period in 2019 (the year before the pandemic)
	Buffering: limiting capacity use	13. Routine medical checks and home visits were reduced (Verhoeven et al., 2020).	Q14 content analysis	Patients were disappointed with the reduced routine medical checks. CNK
	Buffering: limiting capacity use	14. Pharmacies reduced opening hours and restricted the number of visitors at a time (Cadogan & Hughes, 2021).	Q25 content analysis	*Pharmacy access was limited.* PNA
	Buffering: multiple suppliers	15. Medical graduates joined the workforce to provide services (Choi et al., 2020).	Q14 and 25 descriptive analysis	The capacities of GP services were still low as graduates were deployed into supporting roles rather than frontline roles. CNL
	Buffering: excessive production capacity	16. NHS volunteers joined to deliver medicine to patients (Comas-Herrera et al., 2020).	Q25 descriptive analysis	Patients perceived a higher availability of resources for home delivery of medications yet identified a lack of capacity in medicine dispensing service. PNC

[a] Theme codes obtained from content analysis.
[b] Patient quotations.

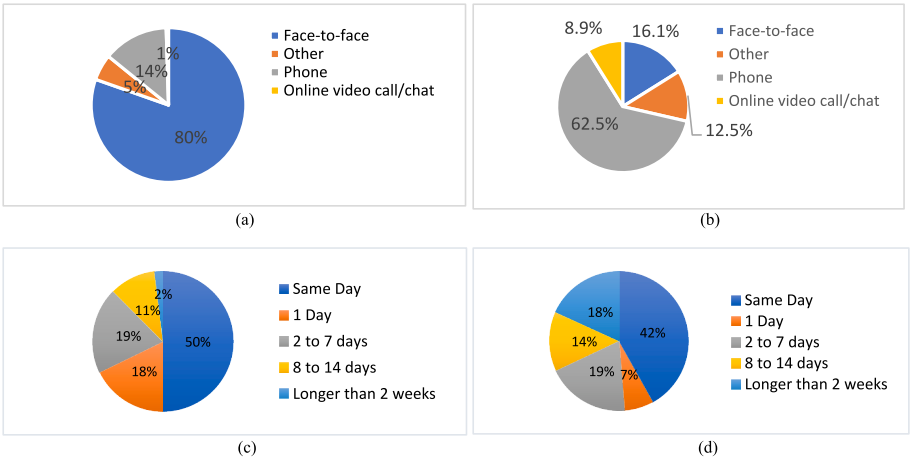

Fig. 4. Medical consultation/treatment appointment modes and waiting times. (a) Appointment modes before lockdown (March–June 2019); (b) Appointment modes during lockdown (March–June 2020); (c) Waiting times before lockdown (March–June 2019); (d) Waiting times during lockdown (March–June 2020).

performance to organizational dynamic capabilities, rather than examining the changes in performance caused by specific dynamic capabilities (Helfat & Winter, 2011). This approach identified both positive and negative consequences of dynamic capabilities for the PCS. Referring to the framework in Fig. 2, we illustrate if and how PCS resilience capability and its attributes altered resources and sustained medical service

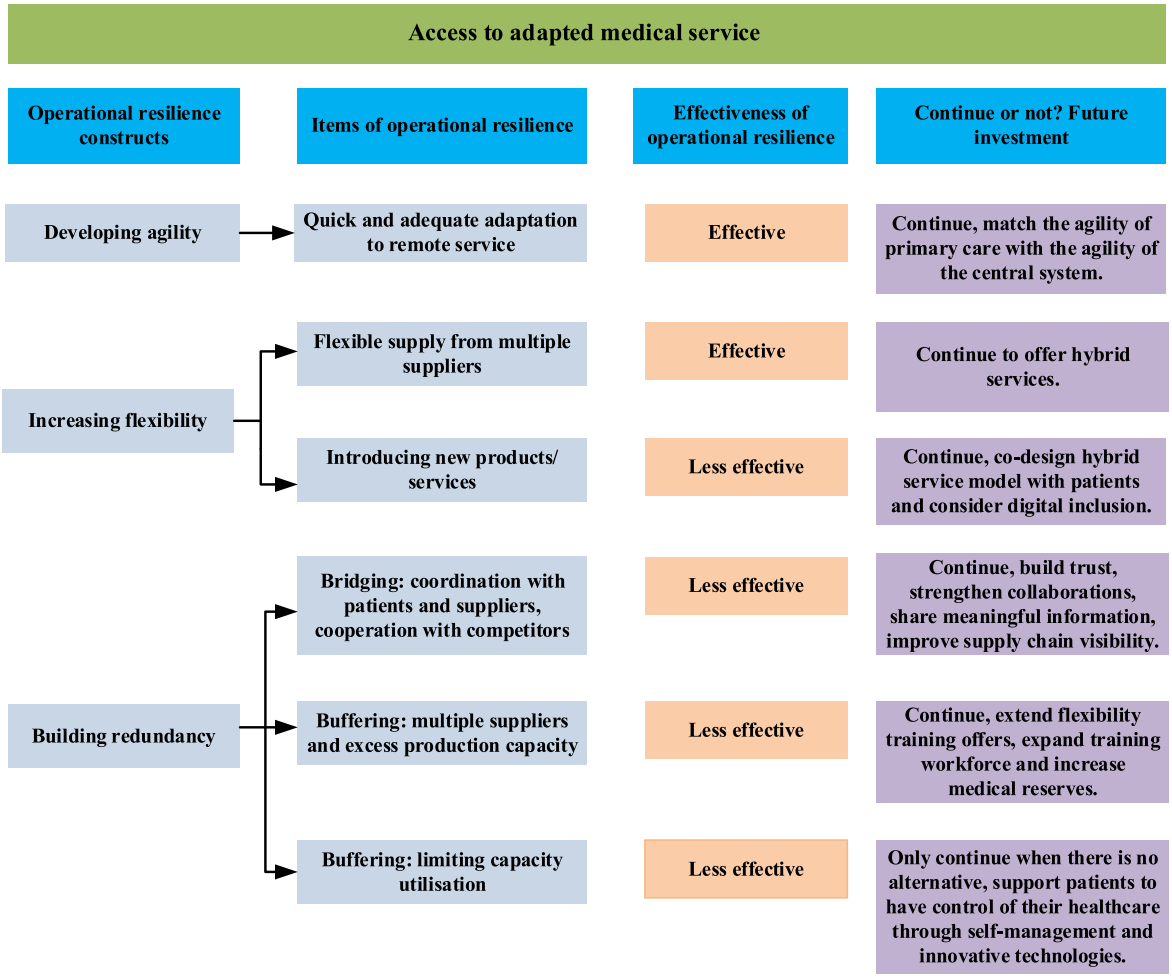

Fig. 5. Effectiveness of PCS resilience in sustaining access to medical service.

provisions, as shown in Fig. 5. *Agility* capabilities enabled quick responses to COVID-19 disruptions, which was clearly supported by two themes from content analysis: quickly introducing multiple channels of medical consultation and medicine prescriptions. Patients had mixed views on the adequacy of the responses, mainly due to delays or shortages in receiving medicines, and a preference for face-to-face consultation.

The *flexibility* capabilities worked very well in maintaining the speed of and enhancing the convenience of medical service provision, but less effectively in maintaining the quality of the service and widening participation from patients. The flexible service portfolio was perceived to be of lower quality than pre-pandemic standards and posed more challenges for certain patients, particularly those having difficulties in communication or navigating digital platforms. These observations were based on the insights obtained from content analysis, reported as reduced routine medical checks, inadequate medical treatment, and delays in dispensing and receiving medicines. New products/service, such as medical apps, were perceived to be complicated, and concerns were raised about data privacy and security.

Patients were more critical about the capabilities of *building redundancy*. *Buffering approaches*, such as increasing service capacity through volunteer/graduate schemes, restricting routine services, and reducing opening hours were less well received by patients. These measures did not increase the core operational capabilities in medical teams or making effective changes in PCS performance. *Bridging measures* were observed in the wider healthcare SC, such as collaborations and joint decision making among medical device providers and medicine suppliers (Scholten & Schilder, 2015). But these measures were not evident at more localized levels due to the low referral rate from GPs and inadequate sharing of pharmacy stock, which undermined the effectiveness of collaboration, joint decision making, and leveraging the pool of resources.

5.2. Dynamic capabilities to continue and strengthen

In answering the second research question, regarding specific dynamic capabilities to be prioritized for future development and investment, we emphasized our recommendations in Fig. 5, focusing on the capabilities based on their effectiveness. It is evident that *developing agility and increasing flexibility* led to positive changes in PCS performance, as reflected in the swift introduction of multiple new service innovations and the rapid transition to remote services. Telephone and video consultations and online prescriptions were valuable additions to PCS service provision and should remain in place. Mobile apps were seen as a convenient method of presenting information to a mass audience, but there were concerns about privacy and violation of civil liberties (Sharma & Bashir, 2020). There is also a need to match the agility of primary care in adopting the hybrid ways of medical service with the agility of the central system in NHS (Green, 2020). Digitalization plays a primary role in increasing flexibility, and it could make positive impacts on patients' experiences, but there are generational and demographic differences in the workplace and among patients regarding their ability to adapt to technological and digital changes. The risks of digital exclusion, lack of digital skills, and overapplication of digital consulting (replacing face to face consulting) were highlighted by patients (Lewis, 2020). Hence, the "correct" proportion of digital consultations should be decided and introduced at an appropriate pace that is both patient-centric and operationally effective.

Creating additional *redundancy* in service capacity was essential (Datta, 2017) and this was observed in GP surgeries and community pharmacies (Stewart et al., 2020). The *buffering measures*, such as increasing workforce by recruiting volunteers and medical graduates, did not work effectively as expected, as these additional workers did not always receive adequate training for the frontline work. Limiting service capacity had a cumulative negative impact on waiting lists and patient health. To redress this issue, healthcare providers should empower patients to manage their conditions (where they are safe to do so) through self-management through education, training, and innovation technologies. Such action can lead to patients receiving safe and appropriate care, with a reduction in demand for medical services. In contrast, *bridging measures* pooled resources together, increased overall resource availability, and strengthened PCS's responsiveness to the disruptions (Scholten & Schilder, 2015) and its ability to hedge against delivery shortfalls (Aldrighetti et al., 2019). However, with reduced service in routine checks and home visits, a redundancy in GP resources became available (Green, 2020). There was a need to redeploy redundant resources effectively to where they were most needed. Preserving functions and resources within and beyond the healthcare system has proven to be very useful in providing additional support to the regular workforce and allows flexibility in managing human resources when crises happen (Haldane et al., 2021). This would be the right approach to cope with future disruptions while maintaining routine medical checks and care. NHS England (2024) has published a long-term workforce plan setting out concrete and pragmatic actions to train, retain, and reform workforce for the next 15 years. The plan sets actions to expand education and training to build broader teams with flexible and right skills, while provide an increased medical reserve to support any future surges in NHS activity.

Leveraging both buffering and bridging strategies to reconfigure resources and build redundancy could lead to higher performances (Manhart et al., 2020). Redundancy and collaboration are very close in proximity, and both should be considered for further investment. Creating slacks or buffers in primary care capacity requires well trained and skilled workforce, supported by the financial fund, innovative technologies and system wide well targeted workforce strategy and plans (NHS England, 2023). PCS stakeholders, including GP surgeries, pharmacies, patients, and the NHS, are encouraged to share vital and meaningful information (medicine inventory stock and patient records) to enhance SC visibility, to build trust and collaboration (effective referral to alternative suppliers), leading to resource redundancy, flexibility, and agility.

6. Conclusions

As the NHS recovers from the pandemic, it is a good opportunity to involve patients and the public in designing PCS as positive changes are identified and consolidated in its service delivery (Lewis et al., 2020). Patients were asked to assess the effectiveness of PCS resilience capability in upholding healthcare services during the COVID-19 pandemic. This assessment provides real-world insights for identifying dynamic capabilities to enhance, thus improving crisis management performance in the future.

Dynamic capability theory was adopted to conceptualize the PCS's resilience capability, and to assess their effectiveness in making performance changes. Patients evaluated this capability's efficacy in driving performance improvements. The PCS's resilience capability, composed of agility, flexibility, and redundancy, enabled gradual enhancement in healthcare services. It effectively ensured uninterrupted delivery of PCS. The effectiveness of PCS's resilience capability depends on whether the capability reconfigures healthcare resources and improves the operational capacity of medical service teams.

Both agility and flexibility are valuable dynamic capabilities that should be maintained. However, it is essential to align the agility of primary care with the central NHS system. The use of technology-driven flexibility should be revaluated to ensure that a hybrid care model caters to diverse patient needs, considering digital inclusion efforts. Developing redundancy through combined buffering and bridging strategies need to be more effective by establishing a larger medical reserve, ready to support future NHS surges.

6.1. Theoretical contributions

This study addresses the need for more empirical research on resilience (Ivanov & Dolgui, 2020), particularly within the healthcare sector. The current literature presents a misalignment between dynamic capabilities theory and empirical measures of performance changes. To date, empirical research has not answered the theoretically and practically relevant questions as to *how* dynamic capabilities change the organizations' resource base and eventually cause changes in performance. The findings from this study caution against an overly optimistic view on the positive impacts made by dynamic capabilities upon organizational or SC performances. Dynamic capabilities change ordinary capabilities or the organizational resource base, which could cause a positive or negative change in performance (Laaksonen & Peltoniemi, 2018), contingent on whether resource redeployment and reconfiguration are right for the evolving environment (Ambrosini & Bowman, 2009).

The current empirical studies also have limitations in identifying *what types* of dynamic capabilities should be developed to make positive changes on performances. It is valuable to examine the effectiveness of specific dynamic capacities in restoring SC performance to a robust state of operation that can lead to competitive advantages (Ali et al., 2017). The findings from this study add new evidence and arguments to the literature in suggesting which dynamic capabilities should be built to induce positive changes in performance, and how to evaluate the impacts of dynamic capabilities upon performance changes (Laaksonen & Peltoniemi, 2018).

6.2. Practical implications

While the NHS and other healthcare systems continue their efforts to recover from the impact of COVID and improve services for patients, this research assesses the effectiveness of specific dynamic capabilities and helps primary care preparing and developing approaches for future health crisis. The analysis emphasizes the need for increasing education and training to develop broader teams with flexible and right skills, while maintaining reserve resources for unexpected crises or surges in demand. Achieving this requires sustained and continued investment in workforce, technology, infrastructure, and innovation. According to the NHS Long Term Workforce plan (NHS England, 2024), the government will invest more than £2.4 billion to fund a 27% expansion in training places by 2028/2029. Furthermore, the research findings strengthen the needs for information sharing, cooperation, and joint decision making, to tackle systemic threats and help avert systemic collapse (Hynes et al., 2020). An ambitious transformation is taking place in PCS in the United Kingdom, with the aim of offering patients with diverse needs a wider choice of personalized and digitally supported health service (NHS England, 2022). The £3.4 billon capital investment in data and technology from 2025/2026 onward will further support this goal. This transformation well aligns with research findings, which encourage patients and healthcare professionals to coordinate, and co-design safe, effective, and sustainable technology driven smart PCS system and solutions.

6.3. Research limitations and future work

This study has several limitations, with the first concerning its scope and the second its coverage in terms of timeline. The scope of this study could be extended to focus on PCS resilience from a more longitudinal perspective, revisiting patients' views on service adaptation periodically (e.g., in 6, 12, and 24 months) to evaluate success in embedding new service provision and gauge resilience attributes and sustainability. The second limitation concerns the timeline and location of the study. The presented views on the PCS are from patients in the United Kingdom during the COVID-19 pandemic. Data were collected during the lockdown period, when patients' emotions were heightened by healthcare fears and the risk of coronavirus infection. Views and expectations at this time will, undoubtedly, have been impacted by this; thus, further research needs to be completed to understand and evaluate the impact of this.

CRediT authorship contribution statement

Ying Xie: Writing – review & editing, Writing – original draft, Visualization, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Liz Breen:** Writing – review & editing, Formal analysis, Data curation, Conceptualization. **Andy Oakey:** Formal analysis, Data curation. **Ozlem Bak:** Project administration, Data curation. **Tom Cherrett:** Project administration, Methodology.

Ethics approval

Ethical approval for all protocols has been obtained from the Research Ethics Committee at the author's own institution. Participants provided informed written consent to be part of the study.

Data availability statement

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

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.emj.2024.10.008.

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