

## Researching big IT in the UK National Health Service

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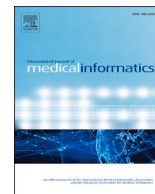
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## Review article

# Researching big IT in the UK National Health Service: A systematic review of theory-based studies

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## ABSTRACT

**Objective:** To identify and discuss theory-based studies of large-scale health information technology programs in the UK National Health Service.

**Materials and Methods:** Using the PRISMA systematic review framework, we searched Scopus, PubMed and CINAHL databases from inception to March 2022 for theory-based studies of large-scale health IT implementations. We undertook detailed full-text analyses of papers meeting our inclusion criteria.

**Results:** Forty-six studies were included after assessment for eligibility, of which twenty-five applied theories from the information systems arena (socio-technical approaches, normalization process theory, user acceptance theories, diffusion of innovation), twelve from sociology (structuration theory, actor-network theory, institutional theory), while nine adopted other theories. Most investigated England's National Program for IT (2002–2011), exploring various technologies among which electronic records predominated. Research themes were categorized into user factors, program factors, process outcomes, clinical impact, technology, and organizational factors. Most research was qualitative, often using a case study strategy with a longitudinal or cross-sectional approach. Data were typically collected through interviews, observation, and document analysis; sampling was generally purposive; and most studies used thematic or related analyses. Theories were generally applied in a superficial or fragmentary manner; and articles frequently lacked detail on how theoretical constructs and relationships aided organization, analysis, and interpretation of data.

**Conclusion:** Theory-based studies of large NHS IT programs are relatively uncommon. As large healthcare programs evolve over a long timeframe in complex and dynamic environments, wider adoption of theory-based methods could strengthen the explanatory and predictive utility of research findings across multiple evaluation studies. Our review has confirmed earlier suggestions for theory selection, and we suggest there is scope for more explicit use of such theoretical constructs to strengthen the conceptual foundations of health informatics research. Additionally, the challenges of large national health informatics programs afford wide-ranging opportunities to test, refine, and adapt sociological and information systems theories.

## 1. Introduction

The UK National Health Service (NHS) has a long history of national health information technology (NHIT) strategies [1] characterized as “natural experiments” in large-scale program implementation [2,3]. Policy aims for NHIT include safety, reduced cost, accessibility, and systems interoperability [4–7], but the outcomes of resulting large and complex programs [8–13] have often been disappointing [14–17]. Some advanced economies with prominent historic NHIT initiatives (e.g., United Kingdom, United States) are reported to achieve comparatively

low ranking for measures of population health (e.g., life expectancy, disease-specific outcomes) versus per capita health expenditure [18] suggesting scope for better understanding of NHIT's contribution to achieving the dual policy goals of effectiveness and efficiency. Identified challenges typically relate to interplay between technical, human, and organizational factors, and authors from various disciplines including pharmacy [19], clinical psychology [20] and medicine [21] have discussed the role of theoretical research in understanding these factors.

Opinions vary among scholars about the value of theoretical frameworks in research [22]. An extreme view posits atheoretical

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qualitative research cannot exist [23] whereas others argue experiential and exploratory studies may not require a theoretical lens [24]. Difficulties in theorizing qualitative evaluations of HIT programs have been ascribed to problems of attributing outcomes, local diversity, long time scales, and dynamic implementation environments [25]. Here, we present a systematic review of theoretical frameworks employed in research on large-scale NHS clinical information systems from 1990 to 2022. Our criteria for large scale were any of: (1) named NHS-wide IT program encompassing multiple components; (2) single application rolled-out across several organizations; (3) initiative to establish connectivity or data flows between multiple organizations; (4) initiative involving multiple professional groups with regional- or national-level oversight. We set out to identify dominant theories and associated methodologies used in such settings, and then evaluate the application of theory using an analysis framework. We aimed to report summary findings across the domain rather than critiques of individual papers.

## 2. Background

After some general considerations of theory, we explore its role in health informatics before reviewing literature proposing candidate theories for researching clinical information systems. Finally, we describe the UK NHS as a testbed for investigating such theories.

### 2.1. Theory

Theory has been described as “a big idea that organizes many other ideas with a high degree of explanatory power” [26] <sup>p2</sup> and “an analytical and interpretive framework that helps the researcher make sense of what is going on” [27] <sup>p103</sup>. Karl Popper [28] <sup>p15</sup> asserted that theories “are nets cast to catch what we call ‘the world’ – to rationalize, to explain and to master it.”.

Theories are dynamic, evolving entities [29] providing shared conceptual models and constructs for describing and explaining complex observed phenomena and their causation [30], identifying contextual influences [31], predicting outcomes, and accumulating evidence from different settings, studies, and researchers [19,21,30,32–35]. Theories relevant to phenomena of interest are considered essential to the development of a strong conceptual research framework (CRF) [36,37] as the basis for formulating research questions, designing methodologies and interpreting findings [38]. In healthcare, it has been suggested theorization can support comparison of interventions, formulating recommendations [20], and synthesizing evidence [39].

Reviews of theory’s role in health informatics [25,32,37,40–44] note many studies lack theoretical rigor, limiting their generalizability and contribution to academic literature [45]. Discussions of its role also need to consider wider contextual questions, including the scope [46,47], distinctiveness and maturity [43] of health informatics as a discipline, contrasting views on informatics as art or science [48,49], the theory-orientation of its practitioners, and challenges of integrating theory and practice in the evaluation of implementations. Historically, health informatics research draws upon both the predominantly positivist disciplines of health and computer science and the more interpretivist management and social sciences. Opinions on the credibility of these epistemological positions vary across stakeholders within the health informatics field [45,50], though a tendency to convergence of positivist and interpretivist theorizations in information systems research has been noted [51].

The choice of theories available to implementation researchers in healthcare has been described as “bewildering” [52] though our preliminary scoping analysis of published material that included a digest of health informatics research approaches [25,45,50,53–56] identified a subset of seven frequently referenced theories that we categorized [51,57,58] as either:

- Used mainly in innovation and information systems research: (1) Socio-technical systems (STS), (2) Normalization process theory (NPT), (3) User acceptance theories, (4) Diffusion of innovation (DOI); or
- Having broader sociological application: (5) Actor-network theory (ANT), (6) Structuration theory, and (7) Institutional theory.

### 2.2. Context and boundaries of this review

A publicly-funded, single-payer healthcare system since 1948, the NHS comprises around 9000 organizations constituted as separate legal entities with considerable autonomy. It has evolved to meet changing demand and user expectations and adapt to clinical and technological advances. Development has proceeded through phases of creation, consolidation, reorganization, and, finally, modernization [59]. The modernization phase has relied substantially on underpinning health-care delivery with information and other technologies.

From 1992 [1], a series of NHIT strategies aimed to facilitate clinical information sharing between practitioners, systems, and organizations, and improve the quality of data for service planning and monitoring. An early emphasis on standards [60] was followed by attempts to introduce accessible life-long electronic health records, and to improve clinical information sharing between healthcare providers and sectors [61]. From 2002 to 2011, a National Program for Information Technology (NPFIT) centralized implementation processes for major NHS applications. Following abandonment of NPFIT in 2011 [62,63], policy reverted to central support and guidance for local initiatives.

The NHS arguably offers a unique testbed for researching NHIT: (1) It aims for comprehensive, integrated healthcare across sectors, while affording considerable local autonomy for provider organizations. (2) Its 30-year history of incremental NHIT strategies has shifted between centralized and decentralized approaches [64]. (3) As a public body, it exhibits considerable transparency and accountability in the management of programs and services and has commissioned evaluations of its IT programs from academic informatics departments.

## 3. Objective

Our objective was to identify and analyze theoretical perspectives used in published studies of large-scale NHS information technology programs and discuss their potential use in future research.

## 4. Methods

The study protocol was registered with the PROSPERO database of international systematic reviews (number CRD42020161766) [65] and we used the PRISMA framework for design and conduct of the research [66].

### 4.1. Search strategy

We used our four criteria for “large scale” to optimize retrieval of relevant articles [67]. Based on criteria (1) and (2) and using a previous analysis of NHS IT programs [1], we designed searches to retrieve reports focused on named programs (e.g., NPFIT) or national systems (e.g., electronic records). Implementations falling short of the scale required for (2), (3) and (4) were excluded later by manual review. Fig. 1 summarizes the search string development, with sample full strings in Appendix A.

Our database selection recognized that studies using sociological theories may be reported in journals outside the medical or informatics areas. To balance multiple searches across disciplines with the need for a tractable and replicable dataset, we adopted a parsimonious and targeted approach [68] selecting Scopus (the largest cross-disciplinary database), PubMed and CINAHL. No start date was specified, and all articles to 22nd March 2022 were included without language restriction.

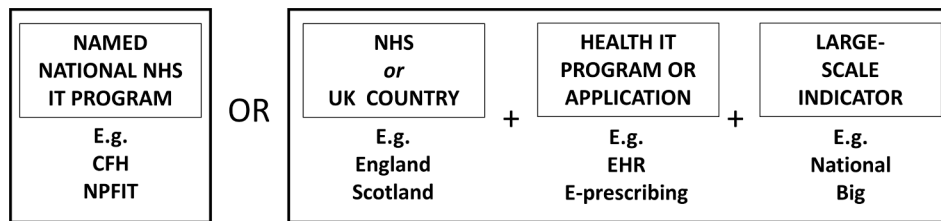


Fig. 1. Schema for search strings. Search keys aimed to retrieve studies of named programs or large-scale application deployment in any part of the UK NHS. Abbreviations: CFH – Connecting for Health; NPFIT – National Program for IT; EHR – Electronic Health Record.

## 4.2. Data processing

### 4.2.1. Stage 1: Screening

Retrieved records were imported into a Microsoft Access database, and duplicates removed, before the three authors independently reviewed all titles, abstracts, and keywords to determine progression to stage 2 using the following criteria. *Inclusion:* named NHS-wide program; explicit mention of theory; interorganizational connectivity; clinical module of national system; multidisciplinary clinical user-base; or centrally managed implementation. *Exclusion:* non-NHS; news item or opinion piece; non-clinical system; technical or standards specification; health IT ancillary to main focus; drug or disease as main focus; or small-scale (<3 organizations). Conflicting decisions were discussed collectively to reach consensus.

### 4.2.2. Stage 2: Eligibility assessment

Retained records from the first stage were imported into an Access database incorporating a form capturing each study's scale, geographical location, organizational and clinical setting, program/application type, research focus/question(s), data collection and analysis methods, and theoretical lens. Each record was reviewed independently and exclusions agreed by all authors to leave the final set for full-text analysis.

### 4.2.3. Stage 3: Full-text analysis

Each author undertook analysis of included articles, extracting and adding information to the Stage 2 eligibility assessment database, amending and augmenting the fields, and adding comments. The authors then discussed, consolidated, and reached consensus on the database entries before the next stage.

### 4.2.4. Stage 4: Critical synthesis

The results for each article were mapped to a descriptive framework (see Appendix B) adapted from other evaluations of theorization [19,34] and using three dimensions:

- (1) *Levels of theory use:* indeterminate, some use of theory, explicitly applied.
- (2) *Utilization of theory components:* constructs, relationships, variables.
- (3) *Stage of theory use:* design, analysis, discussion.

## 5. Results

After statistics on the screening process, we summarize the technology and program focus and funding sources for selected studies; review theories used in these studies; present the research methodologies employed; and finally summarize the results of our critical analysis.

### 5.1. Screening statistics

Database searches yielded 3331 results, with 2628 unique records (Fig. 2). Automated textual analysis of titles, abstracts and keywords identified studies potentially not relevant (e.g., covering disorders, drugs, and non-UK locations) and, through manual checking, 1150 such

records were excluded. Further screening and discussions excluded another 999 records. Following assessment of the remaining 479, 73 studies progressed to full-text analysis. During this process, 27 further articles were excluded as not fitting the review aims (e.g., non-empirical or anecdotal, small-scale, focusing on developing a survey instrument) leaving a final set of 46. Numbers of screened and included articles by year ranges are shown in Fig. 3.

### 5.2. Technology and program focus and funding

In the final 46 studies:

- (a) *IT focus:* 28 (61 %) examined electronic records; 7 (15 %) referral or booking systems; 5 (11 %) prescribing; 2 (4 %) picture archiving and communication systems (PACS); and 1 study (2 %) for each of computerized physician order entry (CPOE), pathology laboratory links, a clinical feedback and audit tool, Health Information Exchanges (HIE), and a community nurse information system.
- (b) *Program focus:* 32 studies (70 %) investigated NPFIT (2002–2011); 9 (20 %) national multi-site initiatives post-2011; 3 (7 %) local multi-site programs; and 2 (4 %) the Delivering Assisted Living Lifestyles at Scale (DALLAS) program. Appendix C details theories used to study each application or system.
- (c) *Funding:* 15 studies (33 %) were financed by a national health research body; 7 (15 %) by national health IT evaluation programs; 3 (7 %) by national innovation and scientific bodies; 3 (7 %) by multiple funding sources; and 2 (4 %) by local health research bodies. Finally, 2 (4 %) received no external funding, and 12 (26 %) provided no statement of funding.

### 5.3. Theories in use

We organized the 46 articles using our two main categories: (1) information system theories (n = 25), and (2) sociological theories (n = 12). A residual group included other theories (n = 9).

#### 5.3.1. Information systems theories

This section presents these theories and their application in the reviewed articles. Table 1 describes study details, and Fig. 4 depicts the relationships between theories, technologies, and research themes.

*Socio-technical approaches* derive from systems theory [93] and have a 50-year history in information systems research [94]. They posit that the outcome of any implementation depends on interaction between social and technical factors. These approaches were used in 11 studies<sup>2</sup> to investigate: user experiences, understanding and engagement in implementations (n = 4); the impact of implementation on work practices and processes (n = 3); safety issues (n = 1); the relationship between culture, strategy and the dynamics of organizational learning (n = 1); implementation challenges and benefits (n = 3); policy-making processes (n = 1); and steps in system development and deployment

<sup>2</sup> Some studies explored multiple topics or systems.

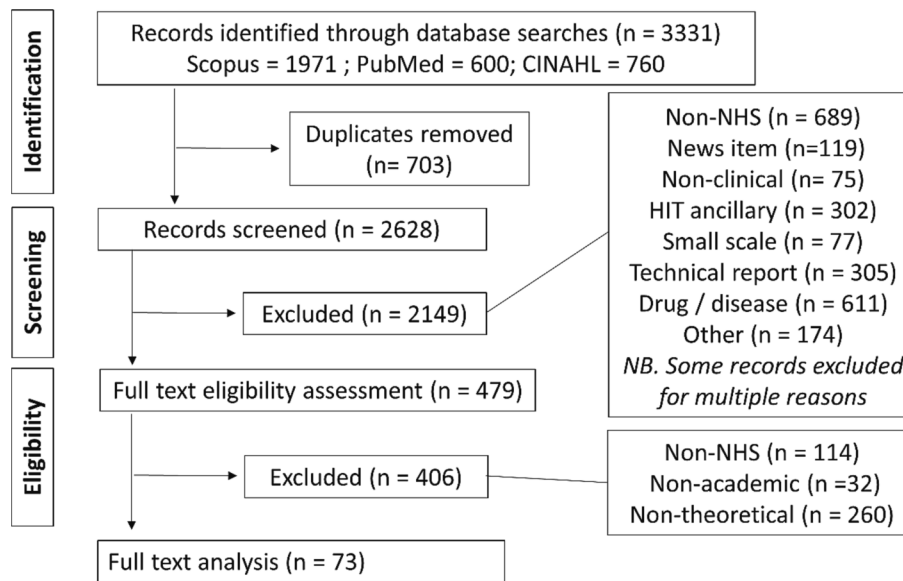


Fig. 2. PRISMA flow chart for the study.

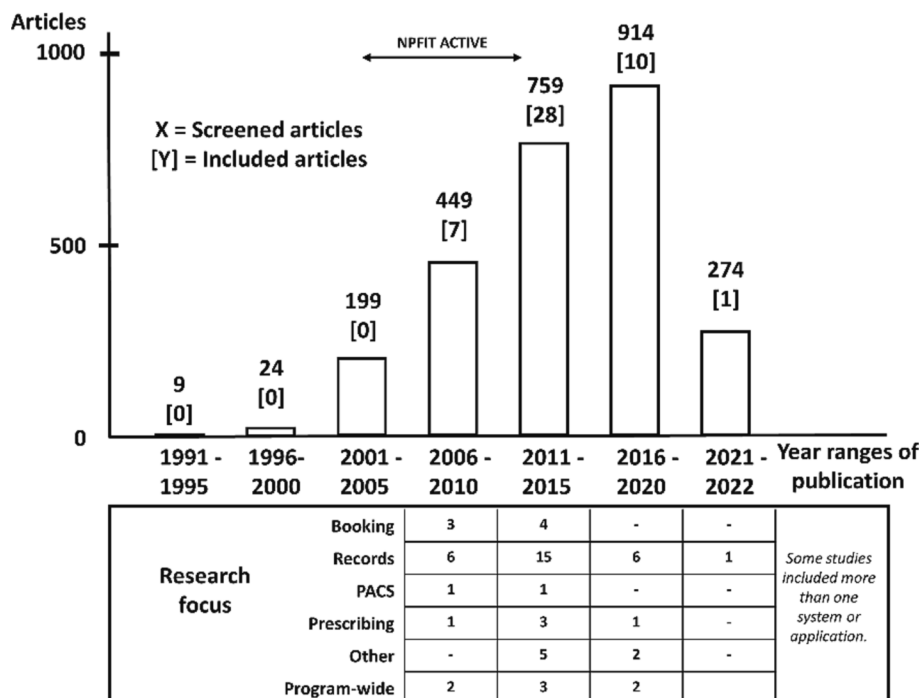


Fig. 3. Screened and included papers, and research focus, by year ranges. Abbreviation: NPFIT – National Program for IT (2002–2011).

(n = 1). The studies focused on hospital electronic records (n = 8), electronic prescribing in community pharmacies (n = 1), and radiologist versus general practitioner (GP) experience of a PACS in a single geographical area (n = 1).

Normalization process theory [95,96] originates from study of healthcare innovations and deals with implementation, embedding and integration of new systems into organizational work practices. Of six studies, 2 evaluated the cross-sector DALLAS program, exploring respectively its design and delivery, and adoption and implementation. The remainder examined a cross-sector implementation of PACS, electronic booking and nurse information systems in 3 local settings (n = 1); implementation challenges for hospital-based pre-operative assessment using an EPR portal (n = 1); GP perspectives on an e-referral system (n

= 1); and staff expectations after procurement of a hospital electronic health record (EHR) (n = 1).

User acceptance theories include the Technology Acceptance Model (TAM) [97] and its derivative the Unified Theory of Use and Acceptance of Technology (UTAUT) [98]. TAM relates variables such as the perceived usefulness and ease of use of the new system, and broader environmental factors, to user behaviors in its adoption. In turn, UTAUT comprises six main variables: performance expectancy, effort expectancy, social influence, facilitating conditions, behavioral intention, and usage behavior. Of four studies, 1 employed TAM to investigate end-user attitudes to a hospital EHR in one region. Another used the Stakeholder Empowered Adoption Model (STEAM) to explore the validity of stakeholder perceptions of benefits of a Personal Health Record (PHR) in



**Table 1**  
Details of studies using information systems theories.

Author(s)	Focus	Design	Data	Analysis
<b>Socio-technical systems approaches [n = 11]</b>				
Carlin et al. (2010) [69]	GPs' & radiologists' user perspectives on local PACS implementation.	Qualitative, cross-sectional, grounded theory.	47 interviews: purposive sample.	Thematic analysis.
Greenhalgh et al. (2010) [70]	Policy making process, implementation by NHS organizations, and experiences of patients and carers.	Mixed methods, cross-sectional, case study.	160 interviews, ethnographic observation of 56 patients or carers. Document analysis.	Thematic analysis.
Cresswell et al. (2011) [71]	User engagement in EHR implementation in 4 hospitals.	Qualitative, longitudinal, case study.	138 interviews, 43 h non-participant observation: purposive sample. Document analysis.	Thematic analysis.
Cresswell et al. (2012) [72]	Change processes in local implementation of national EHR in 3 early adopter hospitals.	Qualitative, longitudinal, ethnographic case study.	88 interviews, 38.5 h observation: purposive sample. Document analysis.	Thematic analysis.
Eason et al. (2012) [73]	Role of national EHR in care coordination across 2 care pathways in a local community.	Qualitative, exploratory, secondary.	Secondary interview data from an earlier study. Document analysis.	Process modelling.
Harvey et al. (2012) [74]	Impact of electronic prescribing system on pharmacy work practices in 15 community pharmacies.	Qualitative, cross-sectional, case study.	> 300 h on-site staff interviews and ethnographic observations: purposive sample. 15 confirmatory interviews.	Thematic analysis.
Takian et al. (2012) [75]	User perceptions of national EHR implementation on work practices in a mental health hospital.	Qualitative, longitudinal, case study.	48 interviews, 26 h observation: purposive sample. Document analysis.	Meta-synthesis of themes.
Meeks et al. (2014) [76]	Safety implications of EHR implementation in 12 hospitals.	Qualitative, longitudinal, case study.	Secondary review of earlier data.	Framework analysis.
Takian et al. (2014) [77]	Impact of vision, culture & strategy on learning during implementation of national EHR in 2 hospitals.	Qualitative, longitudinal, case study.	63 interviews, 41 h observation: purposive sample. Document analysis.	Meta-synthesis of themes.
Waterson. (2014) [78]	Steps in implementation of national HIT systems in 3 large settings.	Qualitative, cross-sectional, case study.	91 interviews: sampling method unreported.	Mixed template and thematic analysis.
Clarke et al. (2015) [79]	Approaches, challenges, and benefits of national EPR implementation in local hospitals and community.	Mixed methods, cross-sectional, case study.	59 questionnaires, 8 interviews: purposive / convenience sampling.	Thematic analysis.
<b>Normalization process theory [n = 6]</b>				
Murray et al (2011) [80]	Assessment of implementation factors for eHealth initiatives (PACS, C&B, CNIS) in 3 local studies.	Qualitative, cross-sectional, case study.	23 interviews: purposive sample	Not reported.
Bouamrane & Mair. (2013) [81]	GP perspectives on management processes in the patient surgical pathway.	Qualitative, cross-sectional.	25 interviews: purposive sample.	Thematic analysis.
Bouamrane & Mair. (2014) [82]	Implementation of a pre-operative assessment portal in a local health community setting.	Qualitative	3 interviews, 1 focus group: purposive sample. 1 organisational case study.	Process mapping Thematic coding.
Devlin et al. (2016) [83]	Adoption barriers and facilitators for DALLAS program.	Qualitative, longitudinal, prospective.	52 interviews. 9 user stories: purposive sample Document analysis.	Thematic coding and mapping to NPT concepts.
Lennon et al. (2017) [84]	Evaluation of processes of designing and implementing digital health through study of DALLAS program.	Qualitative, case study, longitudinal.	125 interviews, 7 focus groups: purposive sample. Additional data from field notes.	Thematic coding and mapping to NPT concepts.
McCrorie et al (2019) [85]	Staff expectations of change, and outcomes after national EHR procurement.	Qualitative, exploratory, cross-sectional.	14 interviews: purposive sample.	Thematic analysis.
<b>User acceptance theories [n = 4]</b>				
Alwarabdeh et al. (2015) [86]	Factors affecting the use of an EHR in a region.	Qualitative, cross-sectional.	6 interviews: snowball sample.	Thematic analysis.
Bidmead & Marshall (2016) [87]	Validity of stakeholders' perceptions of benefits of personal health record in a gastro-enterology setting.	Mixed, case study, cross-sectional.	5 interviews: convenience sample. 56 questionnaires: population sample.	Thematic analysis.
Abd-Alrazaq et al. (2019) [88], (2020) [89]	Level of use of personal health record in primary care in a local setting.	Quantitative, case study, cross-sectional.	624 questionnaires: purposive sample. System use data.	Structured equation modelling.
<b>Diffusion of innovation theory [n = 4]</b>				
Greenhalgh et al. (2008) [90]	Enhancement of existing knowledge on adoption of electronic health records in 4 early adopter sites.	Mixed, utilisation-focussed synthesis.	250 interviews, 1500 h ethnographic observation: convenience sample.	Thematic analysis.
Greenhalgh et al. (2013) [91]	Comparison of 4 UK countries' experience of national EPR implementation	Qualitative, archival (secondary), retrospective.	Review of secondary data from studies of national HIT programs.	Framework analysis.
Cranfield et al (2015) [55]	Adoption and implementation of CPOE and PACS in 4 hospitals.	Qualitative, secondary, sequential.	72 interviews: purposive sample.	Not reported.
Conway et al. (2021) [92]	Uptake of national PHR for diabetes.	Quantitative, retrospective.	39,881 enrolments in national database and annual patient survey results.	Aggregate analysis.

**Abbreviations:** GP - General Practitioner; PACS - Picture Archiving and Communication System; NHS - National Health Service; EHR - Electronic Health Record; EPR - Electronic Patient Record; C&B - Choose & Book; CNIS - Clinical Nurse Information System; DALLAS - Delivering Assisted Living Lifestyles at Scale; CPOE - Computerized Physician Order Entry; PHR - Personal Health Record.

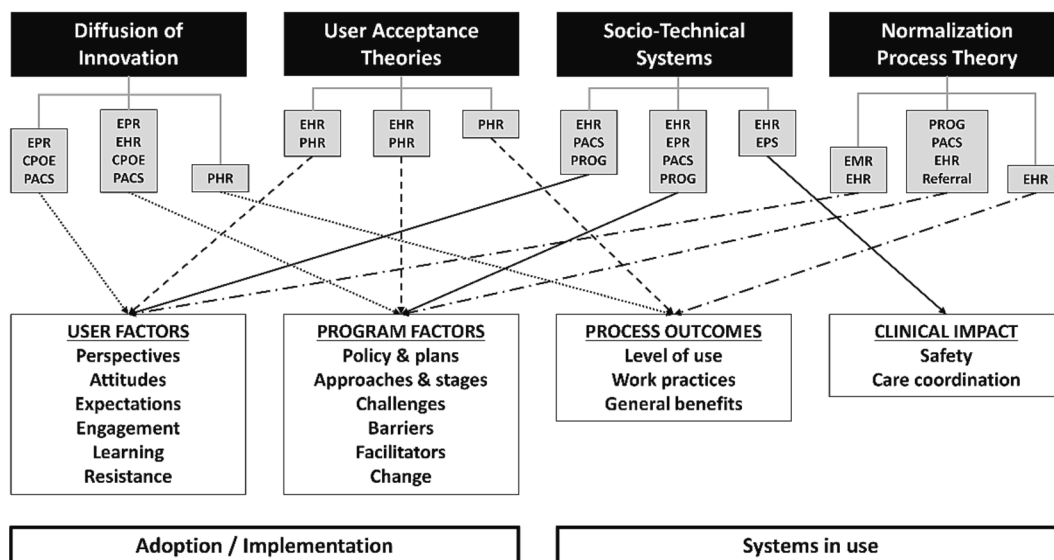


Fig. 4. Relationship between information systems theories, technologies, and research themes. Abbreviations: CPOE – Computerized Physician Order Entry; EHR – Electronic Health Record; EMR – Electronic Medical Record; EPR – Electronic Patient Record; EPS – Electronic Prescription Service; PACS – Picture Archiving and Communication System; PHR – Personal Health Record; PROG – Program with multiple applications.

Table 2  
Details of studies using sociological theories.

Author(s)	Focus	Design	Data	Analysis
Structuration theory [n = 6]				
Greenhalgh & Stones. (2010) [53]	Outcomes from implementation of national electronic records and bookings.	Qualitative, secondary, retrospective.	Data fragments from ongoing ethnographic research studies on NPFIT applications.	Not reported.
Greenhalgh et al. (2010) [100]	Adoption of national summary care record.	Mixed, case study.	Dataset of 416,325 records of primary care encounters, 140 interviews, 2000 pages of ethnographic field notes, 3000 pages of documents.	Thematic and interpretive analysis.
Greenhalgh et al. (2014) [101]	Referral process using national Choose & Book system.	Qualitative, secondary.	Subset of direct observations, video recorded consultations, interviews and documents extracted from HERO dataset.	Interpretive analysis
Greenhalgh et al. (2014) [102]	Resistance to big IT during implementation of national Choose & Book system.	Mixed, secondary analysis of case study data.	Subset of direct observations, video recorded consultations, and interviews. Policy document analysis.	Interpretive analysis
Cresswell et al. (2016) [103]	Stakeholder perceptions on HEPMA implementation in Scotland.	Qualitative	21 participants in multidisciplinary focus group: purposive sample. Cross-sectional.	Thematic analysis.
Jeffries et al. (2017) [104]	Adoption of primary care audit and feedback tool.	Qualitative, case study, cross-sectional.	4 interviews, 5 focus groups with 18 participants in total: purposive sample.	Thematic analysis using template approach.
Actor-network theory [n = 1]				
Cresswell et al. (2012) [105]	Integration of EHR into work practices at 3 hospitals.	Qualitative, case study, longitudinal.	66 interviews, 38.5 h observation: purposive sampling. Document analysis.	Thematic coding.
Institutional Theory [n = 5]				
Currie & Guah. (2007) [106]	Conflicting institutional logics in 6 hospitals.	Qualitative, exploratory, longitudinal.	120 interviews: purposive sample. Field notes from conferences and meetings. Document analysis.	Not reported.
Currie & Finnegan. (2011) [107]	Relationship between policy and practice in EHR implementation in 10 hospitals.	Qualitative, case study, longitudinal.	123 interviews. Conference field notes. Document analysis.	Process-oriented analysis.
Currie. (2012) [108]	Introduction of IT to modernize healthcare in 10 hospitals over 3 regions.	Qualitative, case study, longitudinal.	140 interviews. Document analysis.	Content analysis of documents.
Klecun et al. (2019) [109]	Comparison of EHR implementation in England and Singapore.	Qualitative, case study, longitudinal.	48 interviews. Document analysis.	Thematic and inductive coding.
Guerrazzi. (2020) [56]	Adoption of HIE nationally.	Qualitative, exploratory, retrospective.	Review of literature and policy documents.	Framework analysis.

Abbreviations: NPFIT – National Program for IT; HERO – Healthcare Electronic Records in Organizations; HEPMA – Hospital Electronic Prescribing and Medicines Administration; EHR – Electronic Health Record; HIE – Health Information Exchange.

gastroenterology. Finally, 2 studies by the same author employed UTAUT to examine use of primary care PHRs.

*Diffusion of innovation* theory [99] characterizes the process of adoption of a new product or technology over time. It incorporates a typology of adopters (e.g., early versus late), the innovation itself, the organizational setting, and communications between various players, e.g., opinion leaders and “boundary spanners” who exert influence across multiple organizations. Of four studies, 1 aimed to enhance DOI theory by exploring adoption of Summary Care Records (SCR) in 4 early adopter hospitals; another investigated the adoption of Computerized Physician Order Entry (CPOE) and PACS in 4 acute hospitals; the third analyzed uptake of a PHR for diabetes using enrolment and survey data; the fourth compared progress in EPR adoption across the four UK nations.

### 5.3.2. Sociological theories

This section presents these theories and their applications. Table 2 summarizes study details and Fig. 5 depicts relationships between theories, technologies, and research themes.

*Structuration theory* [110,111] and its adaptation *Strong Structuration theory* [112] focus on the relationship between structure and agency in determining outcomes. Structure includes technology, infrastructure, and organizational setting, while agency represents the actions of actors, who are subject to various influences. The six studies investigated: stakeholder perceptions (n = 1), adoption or non-adoption (n = 2), implementation outcomes (n = 1), resistance to big IT (n = 1), and referral processes (n = 2). The research focus included a clinical commissioning group (CCG) audit and feedback tool (n = 1), a Hospital Electronic Prescribing and Medicines Administration (HEPMA) system (n = 1), the Choose and Book referral system (n = 3), a Local Detailed Record (LDR) (n = 1), and the NHS SCR (n = 1).

*Actor-network theory* [113] conceptualizes implementation as a dynamic network of interacting entities (“actors”), including individuals and physical objects (infrastructure, hardware, and software). The one included article reported integration of EHRs into work practices across 3 hospitals.

*Institutional theory* focuses on the establishment of rules, processes, structures, and systems influencing behavior of individuals within organizations [114]. *Institutional logics* [115] are organizing principles operating within an organizational field (such as healthcare). The outcome of an implementation may depend on the extent to which the logics of different organizations and individuals in the field are in conflict [106]. *Institutional isomorphism* [116] is a process through which structures and processes in one organization come to resemble those of others. The five articles explored: conflicting institutional logics in 6 NHS hospitals implementing NPFIT systems; institutional isomorphism in 10 hospitals implementing NPFIT EHRs; EHR implementation in England and Singapore using institutional and stakeholder theory; the relationship between policy and practice using the Tolbert and Zucker model [106]; and national approaches to Health Information Exchanges (HIE) combining institutional theory and resource-based view (RBV) [117].

### 5.3.3. Other theories

Of nine studies representing “other” theories (i.e., not fitting our two main categories), 4 focused on electronic record systems, 3 on electronic prescribing, 3 on national level programs, and 1 on pathology laboratory links. Table 3 presents details of these theories and their application.

### 5.4. Research methodologies

Table 4 provides methodological information for included articles, including each study’s research strategy, approach, data collection techniques, sampling, and analytical methods.

### 5.5. Critical analysis

Of forty-six papers, 42 (91 %) used a single theory, while 4 (9 %) employed multiple. Table 5 summarizes the results of our critical assessment and demonstrates that, across all three stages of the research process, most articles evidenced “some use of theory”: *design* – 28 (61 %), *analysis* – 30 (65 %), and *discussion* – 24 (52 %). Fewer provided a

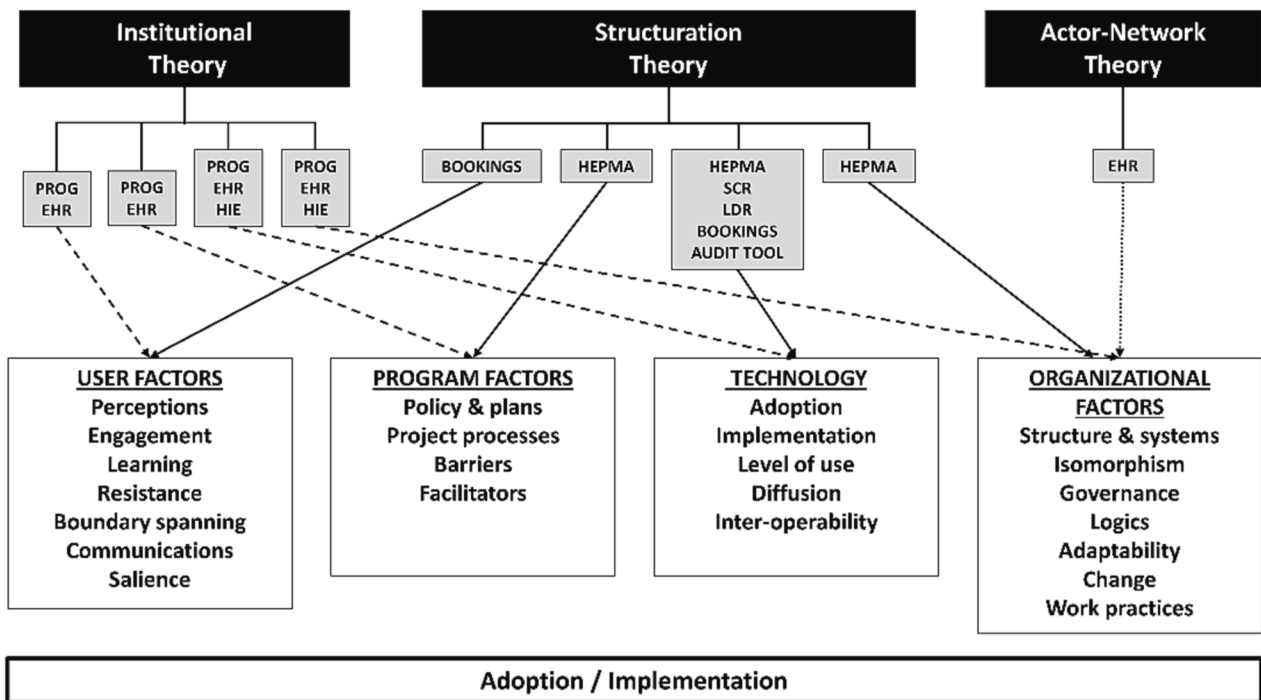


Fig. 5. Relationship between sociological theories, technologies, and research themes. Abbreviations: EHR – Electronic Health Record; EMR – Electronic Medical Record; HEPMA – Hospital Electronic Prescribing and Medicines Administration; HIE – Health Information Exchange; LDR – Local Detailed Record; PHR – Personal Health Record; PROG – Program with multiple applications; SCR – Summary Care Record.



**Table 3**  
Details of studies using other theories (n = 9).

Author(s)	Theory	Focus	Design	Data	Analysis
Ali et al. (2010) [118]	Theories of control. Technology in Practice.	Outcome of implementing EPR and prescribing system in 3 hospitals.	Qualitative, sequential.	Secondary analysis of earlier interviews and observation notes.	Interpretive analysis.
Harvey et al. (2011) [119]	Social construction of technology.	Impact of national electronic prescribing system on work practices in 8 community pharmacies.	Mixed, ethnographic.	Interviews, non-participant observation, shadowing. Sample sizes not reported.	Not reported.
Cockcroft. (2013) [120]	Cynefin framework.	Gaps between media reporting and success factors for NPFIT.	Qualitative, retrospective.	584 news stories.	Lexical analysis.
Constantinides. (2013) [121]	Communicative Constitution of Organizations.	IT innovation within NPFIT.	Qualitative, longitudinal, archival.	Analysis of government documents and oral evidence to parliamentary committees.	Rhetorical analysis.
Eason & Waterson (2013) [122]	Coupling (systems theory).	Implications of different technical strategies for information sharing between national electronic record implementation in 2 local health communities.	Qualitative, secondary.	Data from 40 earlier interviews. Document analysis.	Process mapping.
Wainwright & Shaw. (2013) [123]	Causal modelling.	Organizational collaboration and management issues in pathology laboratory links project.	Qualitative, longitudinal, case study.	8 interviews, participant observation. Document analysis.	Template analysis.
Petrakaki et al. (2014) [124]	Technological affordances.	How implementation of electronic prescribing supports control of prescribing risk in a community pharmacy setting.	Qualitative, longitudinal, case study.	36 interviews: purposive sample. Document analysis.	Thematic and iterative analysis
Petrakaki & Klecun (2015) [125]	Translation and hybridity.	Local customisation of a national EPR in a hospital Trust.	Qualitative, sequential, case study.	26 interviews: purposive sample.	Thematic analysis.
Waring. (2015) [126]	Maturity model.	Implementation of national IT systems in the context of organizational maturity of 11 hospitals.	Qualitative, archival.	299 pages of documents.	Thematic analysis.

*Abbreviations:* EPR – Electronic Patient Record; NPFIT – National Program for IT.

clear explication: *design* – 12 (26 %), *analysis* – 12 (26 %), and *discussion* – 13 (28 %). Authors employing sociological theories appeared to be more likely to provide detailed explanations of their application. Overall, only 6 articles achieved a high level of application across all three stages: 2 from the information systems set (n = 25), 3 from sociology (n = 12), and 1 from the others (n = 9). Most articles (n = 39 or 85 %) identified the theoretical constructs employed, with fewer (n = 16 or 35 %) identifying variables. There was little discussion of relationships between variables (n = 4 or 9 %), reflecting limited use of hypothesis-testing in the included papers. Ten articles reported studies in which theory had been adapted.

## 6. Discussion

Here we consider the prevalence of theoretical studies, the research questions and themes, and the potential of theory to add value.

### 6.1. Prevalence of theory-based studies

While there has been acknowledgement that theory can add value to health informatics research, our review of studies of NHS IT programs suggests that theory-based research on large-scale initiatives has been relatively infrequent. Notably, no theory-based studies predate NPFIT which began in 2002. Possible stimuli for theoretical studies of NPFIT include the scaling-up associated with a centralized program, socio-technical challenges arising from its top-down imposition of national systems [3], the widespread introduction of applications (electronic records, prescribing, PACS, booking) that directly impacted clinical work practices, and professional demands (and available funding) for formative evaluation of a costly, disruptive, and high-profile program [2]. We found little theory-based research in primary care, despite widespread clinical computer use since the 1980s [127]. Suggested reasons for non-use of theory by researchers include lack of awareness of suitable theories for particular areas of enquiry and difficulty selecting from the range of options [52].

### 6.2. Theories and research themes

The wide choice of theories available to implementation researchers in healthcare has been noted [52] though this review confirms a manageable subset in general use. Our results demonstrate that most studies (n = 25) employed information systems theories (STS, NPT, UTAUT, TAM, DOI), with fewer (n = 12) adopting theories from sociology (structuration, institutionalism, ANT), and a small number of studies integrating two theories (e.g., ANT and SST [53]; institutional theory and RBV [56]).

Studies using information systems theories addressed research questions related mainly to adoption facilitators, barriers, and challenges; user experience, engagement, resistance, and learning; perceived changes to work practices; and benefits. Some also explored policy-making, system design and planning. Studies adopting sociological perspectives covered many of the same themes, though with more emphasis on work practices and processes, and organizational factors. The remaining disparate set of theoretical frameworks explored some of the same themes, namely, outcomes (theories of control, technology in practice); work practices (social construction of technology); and organizational and management factors (causal modelling). It also introduced some novel themes: technical strategies and customization (coupling, translation, and hybridity); control of risk (technological affordances); media reporting (Cynefin); organizational factors in innovation (communicative constitution of organizations); and the influence of organizational maturity (maturity models).

Reflecting the importance of human factors in information systems research, methods were almost exclusively qualitative, relying on interviews, focus groups, observation and documentary or archival methods for data collection, and employing some form of thematic analysis. A few researchers have evidently developed expertise in a particular theoretical framework (e.g., institutional theory), but the majority appear to use theory in an *ad hoc* manner, particularly in smaller studies and studies exploring themes outside the clinical arena (e.g., media reporting, technical strategies, inter-organizational management issues). The one theory that was developed specifically for healthcare innovation (NPT) was employed in only 6/46 (13 %) of

**Table 4**  
Methodological details for included studies.

Theory	Strategy					Method			Approach					Data collection					Sample		Analysis									
	CASE STDY	GRD THRY	ETH	EXP	SEC	QUAL	QUAN	MIX	LONG	CROSS	SEQ	PRO	RET	SURV	INTV	FOC GP	OBS	DOC	SEC	PUR	RND	THM	INTP	FRWK TEMP	LEX RHET	META	AGGR	SEM	PROC	
<b>Information systems theories</b>																														
Socio-technical systems	9	1	1	1	1	9		2	5	5				1	10		6	6		7		7		1		1				1
Normalization process theory	2		1			6			2	3		1			6	2			1	6		5								1
User acceptance theories						2		1		3				2	2					3		2								1
Diffusion of Innovation					2	2	1	1				1	2		2		1		2			1		1			1			
<b>Sociological theories</b>																														
Structuration theory	4				3	5		2	1	1			1		5	2	2	3	3	2		4	3							
Institutional theory	3			2		5			4			1			4			5				2		1						1
Actor-network theory	1					1			1						1		1	1		1		1								
<b>Other theories</b>																														
Theory of Control. Technology in Practice.					1	1																	1							
Social construction of technology.				1						1																				
Cynefin framework.						1						1																		1
Communicative Constitution of Organizations.					1	1				1																				1
Coupling (systems theory).					1	1																								1
Causal modelling. Technological affordances.	1					1				1														1						
Translation and hybridity.	1					1						1										1								
Maturity model.					1	1																	1							

*Abbreviations:* CASE STDY - Case study; GRD THRY - Grounded theory; ETH - Ethnography; EXP - Exploratory; SEC - Secondary; QUAL - Qualitative; QUAN - Quantitative; MIX - Mixed methods; LONG - Longitudinal; CROSS - Cross-sectional; SEQ - Sequential; PRO - Prospective; RET - Retrospective; SURV - Survey; INTV - Interviews; FOC GP - Focus group(s); OBS - Observation; DOC - Document analysis; PUR - Purposive; RND - Random; THM - Thematic analysis; INTP - Interpretive; FRWK TEMP - Framework / Template analysis; LEX RHET - Lexical / Rhetorical analysis; META - Metasynthesis; AGGR - Aggregate analysis; SEM - Structural Equation Modeling; PROC - Process analysis.

**Table 5**  
Critical analysis of theorisation in the 46 included papers.

Attribute	Frequency by theory group			
	Overall (n = 46)	Information systems (n = 25)	Sociology (n = 12)	Others (n = 9)
<b>Number of theories</b>				
Single	42 (91 %)	24 (96 %)	9 (75 %)	9 (100 %)
Multiple / hybrid	4 (9 %)	1 (4 %)	3 (25 %)	0
<b>Use in research design</b>				
Indeterminate	6 (13 %)	4 (16 %)	1 (8 %)	1 (11 %)
Some use of theory	28 (61 %)	15 (60 %)	5 (42 %)	8 (88 %)
Explicit	12 (26 %)	6 (24 %)	6 (50 %)	0
<b>Use in data analysis</b>				
Indeterminate	4 (9 %)	2 (8 %)	1 (8 %)	1 (11 %)
Some use of theory	30 (65 %)	17 (68 %)	5 (42 %)	8 (89 %)
Explicit	12 (26 %)	6 (24 %)	6 (50 %)	0
<b>Use in discussion</b>				
Indeterminate	9 (20 %)	8 (32 %)	0	1 (11 %)
Some use of theory	24 (52 %)	11 (44 %)	6 (50 %)	7 (78 %)
Explicit	13 (28 %)	6 (24 %)	6 (50 %)	1 (11 %)
<b>Theory components identified</b>				
Constructs	39 (85 %)	19 (76 %)	11 (92 %)	9 (100 %)
Relationships	4 (9 %)	1 (2 %)	0	3 (33 %)
Variables	16 (35 %)	11 (44 %)	4 (33 %)	1 (11 %)
<b>Adaptations of theory</b>				
	10 (22 %)	6 (24 %)	3 (25 %)	1 (11 %)

included articles.

### 6.3. Adding value through theory

In this review, we have identified theoretical frameworks used in studies of NHS IT programs and examined their application. Summarizing our critique of theorization in the reviewed studies, we note that most used their chosen theoretical framework either superficially (i.e., informing only a part of the research project, such as design or analysis, but not the entire project) or fragmentarily (i.e., using only a subset of constructs associated with the theory, but not the entire range) or nominally (i.e., the purported contribution of the theory to the study was not explicated). Frequently, the articles failed to explain how the chosen theory influenced data collection, analysis, and interpretation. Recurring themes in the authors' own discussions of limitations included small sample sizes, early stages of implementation, short study time frames, partial testing of theories, and unique contextual factors that limit generalizability.

It has been noted that in an area such as information systems implementation, where practical findings can inform key decisions on investment, system design and implementation approaches, many researchers also strive for theoretical contributions [128]. It has been suggested that prospective (design-stage) selection of theory, rather than *post hoc* (analysis stage), engenders a more theoretically-informative engagement between the theoretical lens and the empirical data [31]. Theoretical rigor founded on aligning the entire research process to a clear CRF [36,37] can enhance the trustworthiness of qualitative research as established through criteria of credibility, transferability, confirmability, and dependability [129] but our analysis suggests consistent use of a CRF is exceptional.

We have not found any empirical health informatics studies that compare the impact of theory-based versus atheoretical research, either in the 46 included studies or from our wider reading of the literature, but it has been argued that theorization is important for cumulative development of knowledge in a field [128] and may help to overcome some of the problems identified in health informatics research, such as lack of generalizability. In large strategic NHIT programs, multiple micro-level

evaluation studies typically combine to build a macro-level picture [130,131], but the overall contribution of any one study can be difficult to determine. However, using the same theoretical framework at different times and places, and as change occurs, may bring consistency to studies of familiar NHIT challenges such as local diversity, long time scales, and dynamic implementation environments [7] and help foster a shared understanding of associated phenomena in evolving contexts. This, in turn, may help inform the management of large-scale implementations in complex environments [10,131] where organizational learning may be problematical [132].

Finally, we note one practical obstacle for researchers willing to engage in theory explication in their publications: the word limit for research articles in many health informatics journals. Author guidelines for the journals included in our review suggest that authors might struggle to incorporate detailed theoretical material without sacrificing content of interest to a wider readership (Appendix D).

## 7. Conclusion

This study has added to prior work on the utility of theory by systematically analyzing the theoretical frameworks employed in research on large-scale clinical information systems in the NHS. It has also quantified the extent to which health informatics research, in this context, may be under-theorized. We have also documented the research focus, design and data sources associated with each theory-based study and believe that this will be a useful resource for planning related research. The review's limitations are that (a) it was restricted to the studies of only large-scale implementations in only one national healthcare system, the NHS, and (b) we undertook only a high-level critique of theory application. Future reviews might (a) expand the range of studies to smaller-scale implementations and beyond the NHS and (b) add more detailed critique of theory use. More generally, we note the potential for more program-wide studies of NHIT initiatives. On a practical level, journal editors seeking to advance theory development should encourage authors to provide extended discussions of their use of theory in appendices or supplementary materials.

### CRediT authorship contribution statement

**Colin Price:** Conceptualization, Data curation, Formal analysis, Methodology, Validation, Writing – original draft. **Olga Suhomlinova:** Conceptualization, Formal analysis, Validation, Writing – review & editing. **William Green:** Conceptualization, Formal analysis, Validation, Writing – review & editing.

### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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### Summary Table

What was already known on the topic:

- Policy drivers for large-scale health IT programs include improvements in safety, accessibility, and interoperability, and reduction in cost. Such programs take place over long time scales in complex and dynamic environments where challenges arise from the relationships

between technology, people, and organizations. The outcomes of these IT programs are often reported to be disappointing.

- Identified issues in health informatics research have included generalizability of research findings and contribution to the academic literature, leading to suggestions for more theoretical studies.
- Several theories offer lenses for health informatics studies including socio-technical systems, normalization process theory, user acceptance theories, diffusion of innovation, actor-network theory, structuration theory, and institutional theory.

What this study added to our knowledge:

- This study systematically identified and analyzed 46 articles that used theoretical frameworks in research on large-scale clinical information systems in the UK NHS.
- For each theoretical study reviewed, we documented the qualitative methods used, research themes, and focal applications or systems.
- Theoretical studies were found to be uncommon, and the application of theory was often superficial, fragmentary, or nominal. The articles frequently lacked detail on how theoretical constructs and relationships aided in the organization, analysis, and interpretation of data.
- We identified the opportunity for greater use of studies based on theoretically informed conceptual frameworks to support the cumulative development of knowledge in the area of NHIT.

## Appendix A

### Scopus search strings

TITLE-ABS-KEY (npfit OR “National Programme for Information Technology” OR “National Program for Information Technology” OR “National Programme for IT” OR “National program for IT” OR “Connecting for Health”).

(TITLE-ABS-KEY (uk OR “United kingdom” OR engl\* OR brit\* OR scot\* OR wales OR Ireland OR nhs OR “National Health Service” AND “electronic health record” OR “electronic medical record” OR “electronic patient record” OR “computerized medical record”)) AND (national OR nationwide OR “nation AND wide” OR “large AND scale” OR “large-scale” OR “big”).

(TITLE-ABS-KEY (“summary care record” OR “Personal health record” OR healthspace OR “Health Space” OR “detailed care record”)) AND (nhs OR “national AND health AND service”).

TITLE-ABS-KEY (uk OR “United kingdom” OR engl\* OR brit\* OR scot\* OR wales OR Ireland OR nhs OR “National Health Service” AND “ePrescribing” OR “e Prescribing” OR “electronic prescribing” OR “e-prescribing”).

TITLE-ABS-KEY (uk OR “United kingdom” OR engl\* OR brit\* OR scot\* OR wales OR ireland OR nhs OR “National Health Service” AND “Choose and Book” OR “Choose & Book” OR “ebooking” OR “e booking” OR “electronic booking” OR “e-booking”).

## Appendix B

### Criteria for critical assessment of theorization

#### Level of theory use

Indeterminate	Allusion to the use of theory to inform one or more stages of the research process.
Some use of theory	Explanation of contribution of some theory components to stages of the research process.
Explicitly applied	Clear explication of use of theory in stages of the research process.

#### Utilization of theory components

Constructs	Explanation of the abstract components or concepts forming the basis for the theory.
Relationships	Identification of explicit relationships / correlations between variables that are being tested.
Variables	Identification of independent, dependent, mediating and / or moderating variables relating to the research.

#### Stage of theory use

Research design	Explanation of use of theory in formulating the research questions or hypotheses, developing a conceptual research framework, and / or designing an instrument such as a questionnaire or interview schedule.
Analysis	Explanation of use of theory in the creation of an analysis framework, and / or explicit application of a theory-based framework in the analysis process.
Discussion	Discussion of findings structured using a theoretical framework, and / or includes material on theoretical contribution or adaptation.

## Appendix C

### Theories and themes tabulated by applications and programs.

Program, system or application	Theory	Themes					
		Users	Program	Process	Clinical	TECH	ORG
Audit tool	Structuration Theory						✓
Booking	Structuration Theory	✓					✓
Computerized Physician Order Entry	Diffusion of Innovation	✓	✓				
Electronic Health Record	Diffusion of Innovation		✓				
	User Acceptance Theory	✓	✓				
	Socio-Technical Systems	✓	✓		✓		
	Normalization Process Theory	✓	✓	✓			

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(continued)

Program, system or application	Theory	Themes					
		Users	Program	Process	Clinical	TECH	ORG
Electronic Medical Record	Institutional Theory	✓	✓			✓	✓
	Actor-Network Theory						✓
	Normalization Process Theory	✓					
Electronic Patient Record	Diffusion of Innovation	✓	✓				
	Socio-Technical Systems		✓				
Electronic Prescribing System	Hybridity	✓	✓				✓
	Socio-Technical Systems				✓		
Hospital e-Prescribing & Medicines Administration	Structuration Theory		✓			✓	✓
Healthcare Information Exchange	Institutional Theory					✓	✓
Local Detailed Record	Structuration Theory					✓	
Pathology laboratory links	Causal Modeling		✓		✓		✓
Picture Archiving and Communication System	Diffusion of Innovation	✓	✓				
	Socio-Technical Systems	✓	✓				
	Normalization Process Theory		✓				
Personal Health Record	Diffusion of Innovation		✓				
	User Acceptance Theory	✓	✓	✓			
Program-wide study	Socio-Technical Systems	✓	✓				
	Normalization Process Theory		✓				
	Institutional Theory	✓	✓			✓	✓
Referral system	Maturity Model		✓				✓
	Normalization Process Theory		✓				
Summary Care Record	Structuration Theory					✓	

Abbreviations: TECH – Technical factors; ORG – Organizational factors.

Appendix D

Journal word limits for included papers, as of July 2022.

Journal	Frequency	Word limit
BMC Medical Informatics and Decision Making	5	No set limit
British Medical Journal	4	No set limit
Health Informatics Journal	3	4000
Journal of Information Technology	3	9000
Journal of Medical Internet Research	3	10,000
Social Science & Medicine	3	9000
BMC Health Services Research	2	4500
Informatics in Primary Care	2	Defunct
International Journal of Medical Informatics	2	4000
Journal of the American Medical Informatics Association	2	4000
Studies in Health Technology and Informatics	2	eBook
American Journal of Applied Sciences	1	No set limit
Applied Ergonomics	1	5000
Digital Health	1	No set limit
Health Policy and Technology	1	4500
Health Services and Delivery Research	1	4500
Implementation Science	1	No set limit
Information and Organization	1	Unspecified
International Journal of Public Sector Management	1	8000
Journal of Health Organization and Management	1	8500
Journal of Diabetes Science and Technology	1	3000
Journal of Enterprise Information Management	1	10,000
Journal of Innovation in Health Informatics	1	Defunct
Medical Care Research and Review	1	30 pages
Public Money and Management	1	8000
Sociology of Health and Illness	1	9000
Total	46	

Appendix E

Glossary

Research Terms

Term	Explanation
ANT	Actor-network theory
CINAHL	Cumulative Index to Nursing and Allied Health Literature.
CRF	Conceptual research framework representing the constructs and relationships to be investigated.
DOI	Diffusion of Innovation.
Epistemology	Study of the nature of knowledge.

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Term	Explanation
Framework analysis	Adding new themes from qualitative data to a pre-determined framework.
Interpretive analysis	Interpretation of phenomena and relationships within qualitative data.
Interpretivist	Research that assumes reality is socially-constructed, often using qualitative methods and incorporating subjectivity.
Meta-synthesis	Synthesis of analytical themes from various studies.
NPT	Normalization Process Theory.
Positivist	Research founded on measurement and objectivity, often using quantitative methods.
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-analyses.
PROSPERO	Prospective Register of Systematic Review Protocols.
PubMed	Search engine linked to the MEDLINE database.
Research approach	Design of the study, e.g., longitudinal, cross-sectional.
Research method	Data used in the study, e.g., qualitative, quantitative.
Research strategy	General plan for the study, e.g., case study, exploratory.
Scopus	A bibliographic database covering a range of scientific disciplines.
SEM	Structural Equation Modeling.
SST	Strong Structuration Theory.
STEAM	Stakeholder Empowered Adoption Model.
STS	Sociotechnical systems.
TAM	Technology Acceptance Model.
Thematic analysis	Searching for repeated patterns in qualitative data.
UTAUT	Unified Theory of Use and Acceptance of Technology.

Structures, programs and applications in the context of the UK National Health Service.

Term	Explanation
CCG	Clinical Commissioning Group: <i>Established in 2013 to commission local health services from provider organizations.</i>
CfH	Connecting for Health: <i>The organization responsible for delivering the National Program for Information Technology from 2005 to 2011.</i>
CPOE	Computerized Physician Order Entry.
DALLAS	Delivering Assisted Living Lifestyles at Scale: <i>A UK-wide program using multiple digital resources.</i>
EHR	Electronic Health Record.
EMR	Electronic Medical Record.
EPR	Electronic Patient Record.
GP	General Practitioner: <i>A family physician in the United Kingdom.</i>
HEPMA	Hospital Electronic Prescribing and Medicines Administration.
HERO	Healthcare Electronic Records in Organizations Project.
HIE	Health Information Exchange.
HIT	Health IT.
LDR	Local Detailed Record.
NHIT	National Health IT.
NHS	National Health Service: <i>The publicly-funded free at point-of-care service established in 1948.</i>
NPFIT	National Program for Information Technology: <i>The NHS strategic IT program from 2002 to 2011.</i>
PACS	Picture Archiving and Communication System.
PHR	Personal Health Record.
SCR	Summary Care Record.

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