

Impact of coordination mechanisms based on information and communication technologies on cross-level clinical coordination: A scoping review

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Abstract

Background: Coordination mechanisms based on information and communication technologies (ICTs) are gaining attention, especially since the pandemic, due to their potential to improve communication between health professionals. However, their impact on cross-level clinical coordination remains unclear. The aim is to synthesize the evidence on the impact of ICT-based coordination mechanisms on clinical coordination between primary care and secondary care (SC) doctors and to identify knowledge gaps.

Methods: A scoping review was conducted by searching for original articles in six electronic databases and a manual search, with no restrictions regarding time, area, or methodology. Titles and abstracts were screened. Full texts of the selected articles were reviewed and analysed to assess the impact of each mechanism, according to the cross-level clinical coordination conceptual framework.

Results: Of the 6555 articles identified, 30 met the inclusion criteria. All had been conducted in high-income countries, most ($n=26$) evaluated the impact of a single mechanism – asynchronous electronic consultations via electronic health records (EHR) – and were limited in terms of design and types and dimensions of cross-level clinical coordination analysed. The evaluation of electronic consultations showed positive impacts on the appropriateness of referrals and accessibility to SC, yet the qualitative studies also highlighted potential risks. Studies on other mechanisms were scarce (shared EHR, email consultations) or non-existent (videoconferencing, mobile applications).

Conclusions: Evidence of the impact of ICT-based mechanisms on clinical coordination between levels is limited. Rigorous evaluations are needed to inform policies and strategies for improving coordination between healthcare levels, thus contributing to high-quality, efficient healthcare.

Keywords

ICT-based coordination mechanism, electronic consultations, shared electronic health record, email consultations, care coordination

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Introduction

Clinical coordination across healthcare levels is essential as it improves the care quality, effectiveness, and efficiency of healthcare systems^{1–3} by reducing duplications of diagnostic tests, delays and inconsistencies in treatment, inappropriate referrals, medical errors, and other related problems.^{4,5} It is particularly relevant in National Health Systems (NHS)

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where primary care (PC) serves as the entry point and coordinator of patient care, and also in the care of individuals with complex needs or chronic conditions who often require care across multiple levels over time.^{2,6,7} The pursuit of clinical coordination has originated the development of many healthcare policies and strategies at macro, meso, and micro levels of health systems and services. In this context, information and communication technologies (ICTs) have emerged as tools with great potential to enhance communication among professionals of different care levels.^{6,8,9} These include vertical information systems (e.g. shared electronic health records (EHR)) and mechanisms that support clinical decision-making through synchronous (videoconferencing, phone consultations, messengers/mobile applications) or asynchronous means (electronic consultations via EHR, email consultations, other digital platforms, or mobile applications).¹⁰ However, their impact on clinical coordination, which is the primary objective of these type of mechanisms, has been little explored so far.

Clinical coordination is defined here, following Longest and Young,¹¹ as the harmonious connection of the different health services needed to provide care to patients throughout the care continuum, regardless of the location where they are received, to achieve a common goal without conflicts. Two types are distinguished: (a) clinical information coordination, with its two dimensions, transfer of information between the different services and levels involved in patient care and use of patient clinical information about care received at another level of care, to guide clinical decisions and (b) clinical management coordination, or the sequential and complementary delivery of care by different services, which encompasses three dimensions: care consistency which refers to the existence of similar approaches and treatment objectives among professionals from different levels of care; adequate patient follow-up for the monitoring of the patient when there are transitions from one care setting to another, and accessibility between levels for the provision of care without interruption across levels of care throughout the clinical episode of the patient.¹²

In most healthcare systems worldwide, decision-makers are increasingly allocating more public resources to the implementation of ICT-based coordination mechanisms due to their potential to improve care coordination.^{13–15} For example, from 2000 to 2010, England invested over £12.8 billion in its national information technology programme to implement, among other mechanisms, the shared EHR,¹⁶ and improve cross-level clinical coordination through more accessible and timely information transfer.⁹ Furthermore, electronic consultations via EHR are expected to improve clinical management coordination by enhancing patient follow-up between levels through direct communication for problem-solving, agreement on diagnosis and treatment, and appropriateness of referrals.^{8,17} They also contribute to improved accessibility between levels by reducing waiting times for secondary care (SC).^{17,18} However, the

implementation of ICT-based coordination mechanisms varies greatly between regions, services, and professionals, with some cases being highly limited or localized¹⁴ and there is still limited evidence regarding their actual impact on clinical coordination.^{15,19}

The growing interest in ICT-based coordination mechanisms over the last decade is reflected in a significant increase in literature reviews focusing on various aspects. Some analyse the barriers and facilitators associated with implementing mechanisms like the EHR^{20–23} or electronic consultations via EHR,^{19,24,25} as well as decision support systems such as alert systems and reminders.¹⁵ Others primarily focus on the impact of electronic consultations through EHR on access to SC,^{8,26,27} health outcomes such as diabetes control or chronic renal failure,²⁶ user satisfaction, healthcare costs,^{26,28} and utilization of services (e.g. dermatology).²⁹ There are also assessments of the impact of EHR³⁰ and decision support systems¹⁴ on patient safety and privacy. To date, however, there are no literature reviews that analysed the impact of these mechanisms on clinical coordination between levels comprehensively or on any of its dimensions, which is the objective of its implementation and should be the immediate result and intermediate outcome. This is key to understanding how they may or may not influence the ultimate goals of improved quality, efficiency, and effectiveness of care. This highlights the need for decision-makers to be aware of their contribution and the conditions for their optimal use.

The aim of this review is to summarize the existing evidence on the impact of implementing and utilizing ICT-based coordination mechanisms on clinical coordination between PC and SC doctors, and to identify knowledge gaps thereby contributing to current scientific knowledge and providing guidance for decision-makers in healthcare systems, as increasingly more budgets are being allocated to their implementation, without sufficient evidence of its actual benefits and risks.

Methods

A scoping review of the literature was conducted following Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines³¹ to identify original articles that evaluated the impact of implementing and/or using ICT-based coordination mechanisms on clinical coordination between PC and SC doctors.

The search was conducted without any time or geographical restrictions and included quantitative, qualitative, and mixed-methods studies that analysed the impact of implementing and/or using ICT-based coordination mechanisms (shared EHR, videoconferencing, phone consultations, electronic consultations via EHR, email, other digital platforms, or mobile applications) on various types and dimensions of clinical coordination between PC and SC in healthcare services. Articles addressing the impact

of implementing and using such mechanisms on coordination between health professionals other than doctors, within the same level of care (coordination between different specialties or professionals all belonging to PC or to secondary/tertiary care), or where the healthcare level could not be identified, were all excluded. Opinion articles, commentaries, communications, protocols, and editorials were also excluded.

To identify potentially relevant original articles, a search was conducted in the following bibliographic databases: MEDLINE, LILACS, SciELO, Redalyc, Cochrane Library, and the web search engine Google Scholar. Thesauri used for the search in MEDLINE consisted mostly of free terms and some Medical Subject Headings (MeSH) terms (see Supplemental file 1). Term groups were combined using the Boolean operators 'AND' and 'OR'. The final search strategy for MEDLINE is provided in Supplemental file 2. For the other databases, free terms and their Spanish equivalents were used as appropriate. The final search results were exported to Ryaan[®] and duplicates were removed. Additionally, a second manual search was conducted using the bibliographic references cited in the selected articles from the first search and previously identified literature. The most recent database search to identify newly published articles was performed in May 2024.

The initial selection was conducted by reviewing the titles and abstracts, followed by full-text reading. Where any doubts arose regarding the inclusion of an article, the researchers in the team reviewed it independently and discussed its inclusion. For the final analysis, the articles were categorized according to the conceptual framework developed by Vázquez et al.,³² which distinguishes between two types of clinical coordination: *clinical information coordination*, involving the transfer and use of clinical information between different levels, and *clinical management coordination*, which encompasses consistency of care, appropriate follow-up between levels, and accessibility across levels. This framework was also employed to identify gaps in knowledge related to the aspects studied.

Data regarding the study characteristics (author, year of publication, country of study, methods, population/sample, or data source) and key findings on the elements analysed (type(s) of ICT-based coordination mechanism(s) and dimension(s) of clinical coordination evaluated) were extracted from the identified articles. This information is presented in tables grouped according to the type of method used and the quantitative or qualitative results obtained.

Results

Articles selected

A total of 6555 articles were identified after removing duplicates, of which 162 were fully evaluated and 30 met the inclusion criteria (Figure 1).

Characteristics of the studies selected

A total of 30 studies were analysed; most were published from 2010 onwards and all originated from high-income countries, primarily the United States^{33–52} and Canada,^{53–57} as well as two from the United Kingdom,^{58,59} one from Australia,⁶⁰ one from Netherlands⁶¹ and one from Spain⁶² (Tables 1 and 2). Twelve studies were quantitative in nature, including three cross-sectional studies based on chart reviews^{37,40,62} or surveys conducted among PC doctors³⁴ and SC doctors³⁶ after implementation of the mechanisms; four pre-post evaluations^{33,42,43}; two randomized controlled trials,^{38,39} one non-randomized trial,³⁵ and one retrospective cohort study based on chart reviews⁴⁴ (Table 1). Eight qualitative studies after implementation of the mechanisms were identified, including seven involving PC and SC doctors^{45,46,48,50,52,59,61} and one exclusively focused on PC doctors⁴⁹ (Table 2). Lastly, 10 mixed-methods studies were identified,^{41,47,51,53–58,60} although only two analysed aspects of clinical coordination both qualitatively and quantitatively.^{41,51} The rest only addressed clinical coordination through a quantitative review of medical records^{53,57,58} or through exclusively qualitative methods such as thematic content analysis of open-ended questions,⁵⁴ focus groups^{55,56} and semi-structured interviews^{47,56,60} (Tables 1 and 2).

With regards to the health services studied, slightly over half of the studies assessed the impact of implementing ICT-based mechanisms on clinical coordination between PC and a specific specialty in SC: nephrology,^{53,58,62} endocrinology,^{37,44,57} psychiatry,^{39,56} cardiology,³⁸ dermatology,⁴⁰ paediatrics and subspecialties,⁵⁷ adolescent medicine,⁵² and rheumatology⁴³; and two studies focused on coordination between PC and multiple services: neurology and gastroenterology⁴¹; nephrology, cardiology, and endocrinology⁴⁵; internal medicine, gastroenterology, orthopaedics, surgery, pulmonology, and cardiology.⁶¹ The remaining studies examined the effect on clinical coordination between PC and SC in general, either differentiating between clinical and surgical specialties,³⁶ or with no specification of specialty.^{33–35,42,46–51,54,55,60,63}

In terms of mechanisms, most studies ($n = 26$) analysed the implementation of electronic consultations via EHR between PC and SC doctors^{35–58,60,61}; two studies focused on cross-level consultations via email^{59,62} and two studies examined the use of an EHR shared between care levels.^{33,34} Only 12 studies described the implementation process of the mechanism.^{33,34,37,45,47,52,54,55,57,60–62}

None of the studies comprehensively addressed the impact of the mechanisms on both types of clinical coordination and their five dimensions. With regards to electronic consultations, the majority of the 26 studies focused on analysing a single dimension of clinical management coordination across levels, specifically accessibility,^{37,38,40,42–44,53,57,60} follow-up,^{36,54,55} or consistency.⁴⁵ Three studies analysed

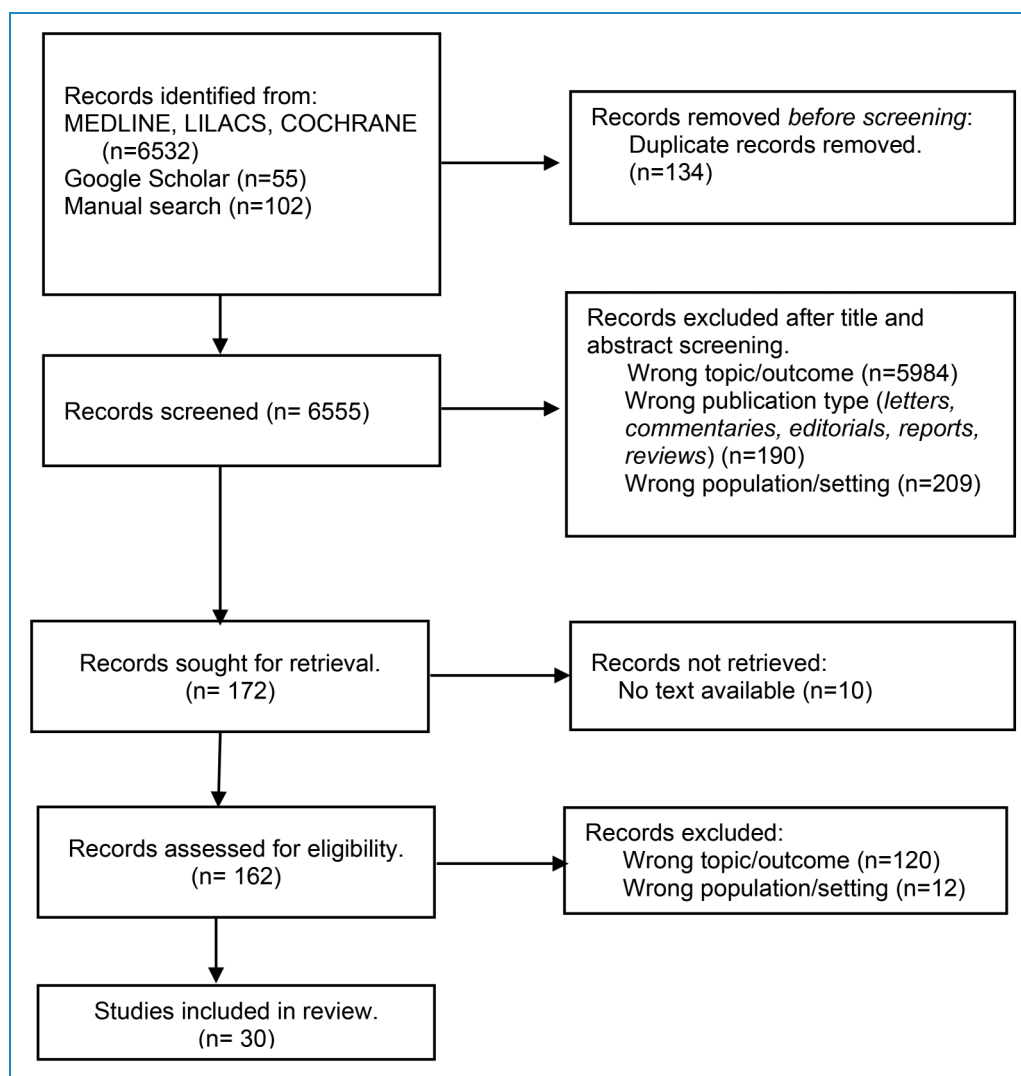


Figure 1. Flowchart illustrating the article selection process.

their impact on two dimensions of clinical management coordination^{39,47,58} and one examined all three dimensions.⁴⁹ The rest analysed a dimension of cross-level clinical information coordination, information transfer, and one or more dimensions of clinical management coordination across levels: follow-up,^{35,50,56} follow-up and accessibility,^{41,46,61} or follow-up and consistency,^{48,51} consistency and accessibility.⁵² As for the shared EHR, both studies analysed one dimension of clinical information coordination (information transfer) and one dimension of clinical management coordination (consistency).^{33,34} Finally, for consultations via email, one study analysed a single dimension of clinical management coordination (follow-up)⁶² and the other examined both a dimension of information coordination (information transfer) and follow-up⁵⁹ (Tables 1 and 2).

Results of the studies

Impact of electronic consultations via EHR on clinical coordination between care levels. Regarding information coordination, of the nine studies that assessed the impact of *electronic consultations* on information transfer between levels, two analysed it quantitatively: a non-randomized clinical trial,³⁵ found that SC doctors from different clinical and surgical specialties who received electronic consultations via EHR reported more frequent receipt of patient clinical information before the appointment. This improvement was also perceived by the patients themselves, while the mixed-methods study,⁵¹ found that the reception of summarized clinical information (65.1%) and clear questions (52.3%) from PC doctors was not as high as expected (Table 1). The results of the qualitative

studies were contradictory.^{41,46,48,50,56} Some studies showed that professionals from various specialties,⁴⁶ internal medicine, orthopaedics, surgery, pulmonology, cardiology,⁶¹ adolescent medicine,⁵² psychiatry,⁵⁶ neurology,⁴¹ and gastroenterology^{41,61} perceived electronic consultations had led to more effective information transfer between care levels, facilitating communication and decision-making on patient treatment and follow-up.^{41,46,52,56,61} Some attributed this improvement to receiving direct advice from specialists.⁴⁸ On the other hand, other studies pointed out that PC and SC doctors considered the received information to be insufficient and inadequate, which could result in delays in patient care,^{41,50} and that communication could be hindered by the unidirectionality of the process (Table 2).

With respect to clinical management coordination, most studies focused on the impact on patient follow-up between levels.^{35,36,39,41,42,46–51,54–56,58,61} Two clinical trials showed that PC doctors who used electronic consultations received treatment and follow-up recommendations from specialists more frequently than those who used paper-based consultations.^{35,39} In line with this, some qualitative studies^{49,55,56,61} indicated that PC doctors perceived an improvement in treatment decision-making for patients due to the support received from specialists through electronic consultations (Table 1).

A quantitative study based on chart review that analysed the clinical appropriateness of consultations sent from PC to nephrology⁵⁸ and another based on surveys of various types of specialists (clinical and surgical)³⁶ found that electronic consultations had a higher level of appropriateness than paper-based consultations.³⁶ However, the results of qualitative studies were contradictory. While some studies conducted with PC doctors,^{49,51,54} and with SC doctors,^{41,46,61} indicated that electronic consultations promoted appropriate referrals, reducing unnecessary ones, another study with doctors from various specialties in SC reported an increase in inappropriate referrals because PC doctors lacked confidence in their abilities and overloaded SC⁴⁷ (Table 2). Furthermore, according to some studies with PC and SC doctors, electronic consultations were considered inadequate mechanisms for patient follow-up as they did not allow for clear assignment of responsibility for patient management^{49,50} (Table 2).

With respect to the impact on accessibility between levels, the majority of quantitative studies based on chart review evaluated specialist response times following implementation of the mechanism^{37,40,41,43,44,53,57} and, in one case, compared them to paper-based referrals.⁵⁸ Two studies analysed waiting times for in-person appointments in SC, comparing electronic and paper-based consultations sent from PC to SC doctors.^{38,39} In all cases, a reduction in specialist response times was observed with electronic consultations. However, the reduction in waiting times for in-person appointments was inconsistent and seemed to vary according to specialty. Some studies showed a

reduction, for example, in cardiology³⁸ and gastroenterology,⁴¹ while others such as psychiatry³⁹ and neurology⁴¹ showed no improvements. Lastly, one study found that the implementation of electronic consultations was not associated with a reduction in consultations from PC that resulted in in-person appointments in SC⁴² (Table 1). The results of qualitative studies were contradictory.^{46,49,52,60,61} Based on studies involving PC doctors⁶⁰ and another with PC doctors, SC doctors,^{52,61} and also patients,⁴⁶ participants reported a notable decrease in waiting times after the introduction of electronic consultations. They attributed this improvement to better communication among health professionals^{52,60,61} and the efficient use of specialists' time by avoiding unnecessary appointments, allowing them to dedicate more time to other patients.⁴⁶ However, another study showed that this mechanism increased waiting times due to the additional information or tests requested by specialists, which in many cases led to more appointments in PC⁴⁹ (Table 2).

Finally, the impact of electronic consultations on the consistency of care between levels was sparsely evaluated. The qualitative studies^{45,47–49,52} that addressed this aspect yielded contradictory results. One study involving PC doctors, nephrologists, cardiologists, and endocrinologists,⁴⁵ and another involving PC doctors and other specialists,⁴⁷ indicated an improvement in joint treatment decision-making. Another involving PC paediatricians and adolescent medicine specialists found that electronic consultations could avoid duplication of test, treatments, etc.⁵² However, other studies involving PC doctors⁴⁹ and other specialists⁴⁸ found that electronic consultations did not effectively support collaboration due to their perceived limitations and impersonal nature, leading to a lack of trust in the treatments and recommendations provided by SC doctors (Table 2). The mixed-methods study⁵¹ found that some primary care physicians described receiving recommendations that they agree on, but others expressed that specialists' responses did not always address their clinical question.

Impact of email consultations on clinical coordination between care levels. Only two studies analysed the impact of implementing email consultations on clinical coordination.^{59,62}

On the one hand, the qualitative study showed that in terms of information coordination, PC and SC doctors perceived that there was increased transfer of paraclinical information (e.g. X-rays, electrocardiograms, dermatological images) from PC to ensure the appropriateness of referral to SC.⁵⁹ Regarding follow-up between levels, it was reported that email consultations helped avoid unnecessary referrals for in-person appointments in SC, especially when related to changes in treatment⁵⁹ (Table 2). On the other, the study based on chart review within a coordination programme between PC and nephrology, which included the implementation of email consultations among other

Table 1. Quantitative studies analysing the impact of ICT-based coordination mechanisms in clinical coordination.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Email consultations							
García M, 2011	Corporació Sanitària i Universitària del Parc Taulí (Spain)	Implementation of a coordination programme between PC and nephrology in 2006 through email consultation and a shared clinical information system	Cross-sectional	Chart review before and after implementation	544 charts from June 2008 to May 2009 and 559 from June 2009 to July 2010	<i>Clinical management coordination: adequate follow-up between levels</i> 559 referral requests were made by email and 188 requests were denied (33.63%) in the period 2009–2010. Progressive increase in the denial of requests for visits to nephrology (28.5% in 2009).	<i>Clinical management coordination: adequate follow-up between levels</i> 559 referral requests were made by email and 188 requests were denied (33.63%) in the period 2009–2010. Progressive increase in the denial of requests for visits to nephrology (28.5% in 2009).
Shared electronic health records							
Graetz I, 2009	Kaiser Permanente Northern California (USA)	Evaluation of the implementation of a shared electronic health record (EHR) system after 1 year	Pre-post study	Surveys of primary care physicians (PCPs)	565 PCPs in 2005 and 678 in 2006	<i>Clinical information coordination: transfer</i> 1. 'Relevant medical information is available'. 2. 'The information transfer is timely, i.e. available when it is needed'. <i>Clinical management coordination:</i> 1. 'Clinicians agree on the treatment goals and plans'. <i>Clinical management coordination: consistency between levels</i> 1.11–1.90). Clinicians who used EHR for more than 6 months were significantly more likely to report having access to timely and complete information than those without EHR (OR = 2.69; 95% CI: 1.63–4.45). Clinicians who reported systematic EHR use were also more likely to report access to timely and complete information than those without EHR (OR = 1.49, 95% CI: 1.11–1.90). <i>Clinical management coordination:</i> consistency between levels Clinicians who used EHR for more than 6 months were significantly more likely to report agreement on treatment goals and plans than those pre-EHR (OR = 1.86, 95% CI: 1.12–3.11).	<i>Clinical information coordination: transfer</i> Clinicians who used EHR for more than 6 months were significantly more likely to report having access to timely and complete information than those without EHR (OR = 2.69; 95% CI: 1.63–4.45). Clinicians who reported systematic EHR use were also more likely to report access to timely and complete information than those without EHR (OR = 1.49, 95% CI: 1.11–1.90). <i>Clinical management coordination:</i> consistency between levels Clinicians who used EHR for more than 6 months were significantly more likely to report agreement on treatment goals and plans than those pre-EHR (OR = 1.86, 95% CI: 1.12–3.11).
Graetz I, 2014	Kaiser Permanente Northern California (USA)	Evaluation of the implementation of a shared outpatient electronic health record (EHR) system and integrated outpatient inpatient EHR	Cross-sectional	Surveys of primary care physicians (PCPs) in 2005, 2006, and 2008	In 2005, 565 PCPs, 678 in 2006, and 626 in 2008	<i>Clinical information coordination: transfer</i> 1. 'Relevant medical information is available'. 2. 'The information transfer is timely, i.e. available when it is needed'. <i>Clinical management coordination:</i> 1. 'Clinicians agree on the treatment goals and plans'. <i>Clinical management coordination: consistency between levels</i> 1.24–4.09, $p < 0.01$). Clinician agreement on the patient's treatment goals and plans was higher with the outpatient inpatient EHR (OR = 1.80, 95% CI: 1.01–3.19, $p < 0.05$) than with no EHR use, as was agreement on each other's roles and responsibilities (OR = 1.51, 95% CI: 1.31–4.34) for patients transferred between clinicians.	<i>Clinical information coordination: transfer</i> Compared to no EHR, the use of the integrated outpatient inpatient EHR was associated with a significantly higher number of reports of complete and timely information (OR = 2.25, 95% CI: 1.24–4.09, $p < 0.01$). <i>Clinical management coordination: consistency between levels</i> Clinician agreement on the patient's treatment goals and plans was higher with the outpatient inpatient EHR (OR = 1.80, 95% CI: 1.01–3.19, $p < 0.05$) than with no EHR use, as was agreement on each other's roles and responsibilities (OR = 1.51, 95% CI: 1.31–4.34) for patients transferred between clinicians.

(continued)

Table 1. Continued.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Electronic consultations via EHR							
Gandhi, T, 2008	Two community health centres in the Partners HealthCare System in Boston (USA)	Implementation of an electronic referral tool within the electronic record to improve communication between primary care physicians (PCPs) and specialists in the Partners HealthCare System in Boston	Non-randomized clinical trial	Survey of PCPs, specialists, and patients involved in the referral	Intervention group (electronic consultations): 12 PCPs, 141 specialists Control group (traditional paper-based consultations): 7 PCPs, 94 specialists	<i>Clinical information coordination:</i> transfer specialist's receipt of referral information from the PCP prior to the patient visit. <i>Clinical management coordination:</i> adequate follow-up between levels the specialist after the patient's specialist visit	<i>Clinical information coordination: transfer</i> Specialists received information before the referral visit more often from intervention PCPs than non-intervention PCPs (62% vs. 12%, $p < 0.0001$), (OR = 3.3, $p = 0.008$). Intervention patients were significantly more likely to report that specialists had received information prior to their visit (70% vs. 43%). <i>Clinical management coordination: adequate follow-up between levels</i> Intervention PCPs received return communication from specialists more often (69% vs. 50%, $p = 0.08$).
Kim-Hwang J, 2009	San Francisco General Hospital and Trauma Center (USA)	Comparison of electronic referral vs. paper-based referral made from PC	Cross-sectional	Surveys of SC clinicians in 2007 and 2008	309 medical specialists and 196 surgical specialists	<i>Clinical management coordination: adequate follow-up between levels</i> appropriateness of the referral	Medical specialists considered the referral inappropriate for 6.4% of new patients referred via paper-based methods vs. 2.6% of new patients referred by eReferral (p -value 0.21). Surgical specialty clinicians considered the referral to be inappropriate for 9.8% (paper-based methods) vs. 2.1% (eReferral) of visits.
Stoves J, 2010	The Bradford and Airedale Primary Care Trust and Renal Unit (England)	Implementation of a centralized IT system (SystemOne) that allows electronic consultations between PC and nephrologists	Mixed-methods	Chart review before and after implementation of the electronic consultation service	376 paper-based consultations, 68 electronic consultations	<i>Clinical management coordination: adequate follow-up between levels</i> comparison of the appropriateness of electronic consultations vs. paper-based consultations <i>Clinical management coordination: accessibility between levels</i> timeliness of responses	<i>Clinical management coordination: adequate follow-up between levels</i> When PCPs were requesting clinic review for a patient by letter, only 56% of referrals were appropriate according to local criteria. By contrast, 90% of e-consultations requesting clinic review were appropriate. <i>Clinical management coordination: accessibility between levels</i> The mean interval between the PCP sending an electronic consultation referral and the renal specialist submitting an electronic response was 7 (0.8) days. This contrasted with a mean wait of 55.1 (1.6) days between the PCP sending a paper referral and the patient's visit to the specialist.
Cruz ML, 2015	University of California, San Francisco Medical Center (USA)	Implementation of a electronic consultation system and a referral decision support system within EHR from PC to SC services	Cross-sectional	Chart review completed within the first year of the electronic consultation (eConsult) programme (1 September 2012 to 31 August 2013)	All endocrine electronic consultations ($n = 158$) made during the observation period between PCPs and endocrinologists	<i>Clinical management coordination: accessibility between levels</i> % of patients with timely endocrine access	Over the timeframe, 49.3% of patients had timely endocrine access, defined as specialist input via eConsult or office-based visit within 14 days of referral, as compared to 21.2% of patients referred during the previous year (odds ratio (OR), 3.6; 95% CI: 2.7–4.9).

(continued)

Table 1. Continued.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Nwando J, 2016	Community Health Center, Connecticut (USA)	Comparison of an e-consultation via EHR pathway and traditional referral system for PCPs to consult with cardiology	Randomized clinical trial	Chart review after follow-up of PCPs for 1 year	19 PCPs in control group and 17 in the electronic consultation group	<i>Clinical management coordination: accessibility between levels completed consultation with the cardiologists; median days to a review from the specialists</i>	Patients in the intervention group, for whom electronic consultations were made by PCP doctors, were almost 4 times (OR = 3.74, 95% CI: 2.60–5.39) more likely than control patients to have had their case reviewed by a cardiologist. Median days to a review for an electronic consultation vs. a visit face-to-face for control patients were 5 and 24 days, respectively.
Golberstein E, 2018	Allina Health Integrated Delivery System, Minnesota (USA)	Evaluation of PCPs' use of an electronic consultations model (e-consult through EHR + financial incentives for psychiatrists) for mental health services	Randomized clinical trial	Surveys before and after implementation both in control (traditional referral) and intervention group (e-consult referral)	72 PCPs in control group and 70 in intervention group	<i>Clinical management coordination: adequate follow-up between levels</i> Mean score (on a scale of 0–5) for agreement about having the support and help needed to effectively deal with mental health problems in PC after 6 months of intervention. <i>Clinical management coordination: accessibility between levels</i> 1. Mean score (on a scale of 0–5) for how quickly PCPs think patients are able to access mental health specialty care 2. Mean score (on a scale of 0–5) for how easy/difficult PCPs think it is to get a mental health appointment	<i>Clinical management coordination: adequate follow-up between levels</i> Mental health eConsults significantly improved perceptions that PCPs had the help and support they needed for diagnosing mental disorders; pre-intervention mean (2.8) SD (1.1), mean after 6 months (3) SD (0.16) ($p=0.004$); making treatment decisions; pre-intervention mean (2.99) SD (1.1), mean after 6 months (3.02) SD (0.19) ($p=0.043$). <i>Clinical management coordination: accessibility between levels</i> Exposure to eConsults significantly improved PCPs' perceptions of how easy it is to get a mental health appointment: pre-intervention mean (2.32) SD (1.1), mean after 6 months (2.17) SD (0.2) ($p=0.026$) but did not affect how quickly they thought mental health services can be accessed or how often the PCP consults with a mental health specialist.
Lai L, 2018	The Champlain Local Health Integration Network, Ontario (Canada)	Implementation of the Canadian Champlain BASE™ (Building Access to Specialists through eConsult) electronic consultations service between PCP and a tertiary care paediatric hospital	Mixed-methods	Chart review of referrals made from July 2013 to April 2016	1064 referrals directed to 14 specialty services	<i>Clinical management coordination: accessibility between levels overall</i> median wait-time of electronic consultations compared to face-to-face referral	The overall median wait-time of specialty services for a eConsult (1 day; 95% CI: 0.9–1.2) compared with a face-to-face referral (132 days; 95% CI: 127–136) was significantly shorter ($p < 0.001$).
Rea CJ, 2018	Boston Children's Hospital primary care clinic (USA)	Implementation of a consultation and referral system within the EHR (shared care) between PCP and specialists (neurology and gastroenterology)	Mixed-methods	Chart review conducted from 2014 to 2016. Survey of PCPs and specialists	510 Shared Care consultations made by 82 PCPs	<i>Clinical management coordination: accessibility between levels average appointment wait-time</i>	Wait-times for routine appointments in the gastroenterology department decreased after Shared Care was introduced (41 to 27 days, $p < 0.01$). This was not the case for the neurology department (53 to 50 days, $P = 0.32$).
Ong S, 2019	Toronto Central Local Health Integration Network (Canada)	Comparison of the implementation of a web-based electronic consultation platform through the Ontario Telemedicine Network between PCPs and Nephrologists vs. traditional referral	Mixed-methods	Chart review conducted from January 2018 to January 2019	106 electronic consultations and 250 traditional referrals made by 52 PCPs and 23 nephrologists	<i>Clinical management coordination: accessibility between levels median wait-time for a first appointment from the time of referral</i>	Median time with traditional referrals was 111 (62–163) days, while with electronic consultation was 19 (6–81) days.

(continued)

Table 1. Continued.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Seiger K, 2020	Massachusetts General Hospital and outpatient centres (USA)	Implementation of a paediatric dermatology eConsult programme	Cross-sectional	Chart review of all patients under 18 years for whom a paediatric dermatology eConsult was completed from programme inception on 1st November 2014, through to 31st December 2017	188 electronic consultations	<i>Clinical management coordination:</i> accessibility between levels average time between referral submission and completion	The average appointment wait-time for patients with a completed eConsult was 37.3 calendar days, which was 31% shorter than the 54.1 calendar day wait-time for patients referred without an eConsult from 2016 to 2017, before implementation of the programme.
Wood B, 2020	University of Washington (UW), Seattle, Washington (USA)	Implementation of a electronic consultation (eConsult) programme between PCPs and specialists	Pre-post study	Chart review of electronic consultations completed from April 2018 to August 2019	324 electronic consultations	<i>Clinical management coordination:</i> accessibility between levels % of in-person referrals after consultation before and after the implementation of eConsults	Mean total number of in-person infectious diseases (ID) referrals from UW network PCPs in the 12 months prior to ID eConsult launch and 12 months post-launch were 208.75 and 215.83, respectively ($P=0.41$). Mean percentage of in-person referrals from UW network PCPs seen within 30 days pre- vs. post-launch were 73.48% and 72.78%, respectively ($P=0.7$); mean percentage seen within 14 days pre-launch compared with post-launch were 49.57% and 53.25%, respectively ($P=0.11$).
Patel V, 2020	Michael E. DeBakey Veterans Affairs Medical Center (USA)	Implementation of electronic consultations for positive ANA referrals to rheumatology	Pre-post study	Chart review of positive ANA referrals from 1st January 2015 to 31st March 2017	139 referrals (126 before the implementation of electronic consultations)	<i>Clinical management coordination:</i> accessibility between levels average time between referral submission and completion	The average in-person visit wait-time for a positive ANA referral decreased from 64 to 34 days after electronic consultations implementation ($p<0.001$).
Anderson D, 2020	Community Health Center, Connecticut (USA)	Implementation of a web-based electronic consultation (eConsult) platform for endocrinology consultations	Retrospective cohort study	Chart review of Medicaid patients referred to an endocrinologist in the year before the implementation of eConsults and those referred in the year after implementation	365 in the year before eConsult implementation and 469 after electronic consultations were introduced	<i>Clinical management coordination:</i> accessibility between levels median time to consult resolution (defined as the time between referral request and completion of a face-to-face visit or an eConsult, indicating no need for a face-to-face visit)	Before the eConsult implementation, the median time to consult completion was 79 days. In the post-eConsult period, patients who were referred directly for face-to-face visits had a median of 87 days to completion, whereas patients who were referred for eConsults had a median of <24 hours to eConsult completion. Patients who needed a face-to-face visit after their initial eConsult had a median time to completion of 107 days. These differences were not statistically significant.
Bifulco, 2023	Federally Qualified Health Centers, Texas (USA)	Implementation of a web-based electronic consultation (eConsult) platform for several specialties	Mixed-methods	Semi-structured interviews	9 PCPs	<i>Clinical management coordination:</i> consistency between levels PCP doctors agree on the treatment goals and plans proposed by specialists. <i>Clinical management coordination:</i> adequate follow-up between levels Ability and willingness	<i>Clinical management coordination: consistency between levels:</i> Several PCPs described receiving eConsult recommendations that were medically appropriate but impracticable for their low-income, uninsured patients and that was the primary reason for not applying the recommendations made. But others expressed that specialists' responses did not always address their clinical question. <i>Clinical management coordination: adequate follow-up between levels</i> PCPs noted the ease of using eConsults to help patients avoid face-to-face referrals.

ICT: information and communication technologies; CC: clinical coordination; PCP: primary care physicians; EHR: electronic health records; SC: secondary care; OR: odds ratio; 95% CI: confidence interval.

measures, found an increase in inappropriate referrals from PC after the mechanism was implemented⁶² (Table 1).

Impact of shared EHR on clinical coordination between care levels. Only one experience was identified with two evaluations, at 6 months and 3 years after implementation, analysing the impact of the shared EHR on the coordination of information and clinical management via surveys of PC and SC doctors.^{33,34} After the first 6 months, doctors who systematically used shared EHR reported improved access to timely and complete information and greater agreement with treatments and management prescribed by the other level, compared to the pre-implementation period.³³ At 3 years, shared EHR use continued to be associated with increased access to complete and timely information, agreement with treatments and management prescribed by the other level, and furthermore, greater clarity in roles and responsibilities during care, compared to non-use of shared EHR³⁴ (Table 1).

Discussion

Despite the widespread promotion of ICT-based coordination mechanisms as tools to enhance communication among health professionals, their rapid implementation in healthcare systems driven by decision-makers, particularly in the context of the COVID-19 pandemic, and the growing number of publications, the evidence on their impact on clinical coordination between care levels remains unclear. Clinical coordination is a crucial objective and component in ensuring high-quality healthcare.⁶⁴ This scoping review represents a first attempt to comprehensively synthesize the available evidence on the impact of ICT-based coordination mechanisms on clinical coordination between care levels, using a defined theoretical framework.³² The aim is to contribute to the generation of scientific evidence and identify existing gaps, thus enabling decision-makers to guide improvement strategies and future research endeavours.

The results indicate that, overall, there are few studies available on the impact of different ICT-based coordination mechanisms on clinical coordination between care levels. All the studies were conducted in high-income countries, within diverse healthcare settings, and with varied study designs and evaluated outcomes. Very few studies described the implementation process. All these factors hinder comparison and limit the generalizability of the findings. The majority of studies were quantitative and focused on the impact of electronic consultations via EHR on clinical coordination between PC and specific specialties in SC. Most studies examined clinical management coordination, follow-up, and accessibility between levels, and to a lesser degree on information transfer and care consistency. None of the studies comprehensively addressed the impact across all dimensions. Very few studies evaluated the

impact of email consultations or shared EHR, and for other mechanisms such as electronic videoconferencing, web platforms, and mobile applications, no studies exist. Both quantitative and qualitative studies reported benefits of implementing ICT-based mechanisms across the evaluated dimensions. However, qualitative studies also highlighted some risks associated with their introduction, which should be considered when implementing these strategies in healthcare systems. It is important to note that very few studies were clinical trials or pre-post evaluations, which are the most suitable types of studies for assessing interventions in healthcare systems, as they allow us to establish causal relationships between the intervention and the outcomes.⁶⁵ This underscores the need to encourage comprehensive approaches that delve into the impact of implementing and utilizing these mechanisms (Supplemental file 3).

Studies from high-income countries focusing on electronic consultations, with limited analysis of process and outcomes

It is noteworthy that all the studies were conducted in high-income countries, which may be related, among other factors, to the high investment required to implement such mechanisms in healthcare systems,¹⁵ which may not be available in middle- and low-income countries, thus restricting their introduction and consequently their evaluation. Even within the same country there are differences in the strategies and the way they are implemented in different regions,^{15,27} so caution should therefore be exercised when extrapolating the results, as they come from specific contexts that are difficult to reproduce in regions with limited economic, technological, and infrastructural resources or where health systems are not well structured. Additionally, few studies^{33,34,37,45,47,54,55,57,62} analysed the influence of the context, the content of the intervention, and implementation process on the clinical coordination outcomes of the interventions analysed.^{66,67} These studies, mostly focused on the influence of content and process, highlight the importance of integrating the mechanisms into broader strategies to improve coordination between levels,⁶² introducing financial incentives,^{19,37} providing adequate training for their use, ensuring good technical support for troubleshooting,²² and establishing clear technical and legal policies to guarantee information security,³⁰ in order to encourage the use of the mechanism and influence their ultimate impact on clinical coordination between levels. Therefore, implementation research is required to analyse, in addition to effectiveness, the influence of context and the process of implementation of interventions⁶⁸ in order to interpret the findings and make appropriate extrapolations to other contexts.

Furthermore, it is worth noting that the majority of studies focused on the impact of electronic consultations

Table 2. Qualitative studies analysing the impact of ICT-based coordination mechanisms in clinical coordination.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Email consultations							
Sampson R, 2016	NHS Highland (Scotland)	Implementation of email communication between clinicians across the PC-SC interface	Qualitative	Semi-structured interviews from August to December 2014	10 PCPs and 12 hospital consultants	<p><i>Clinical information coordination between levels of care: transfer</i></p> <p><i>Clinical management coordination: adequate follow-up between levels</i></p> <p>general perceptions of email use in practice</p>	<p><i>Clinical information coordination between levels of care: transfer</i> Practitioners perceived email as a method of overcoming accessibility barriers. Email communication was more likely where a previously established working relationship existed between clinicians working across the interface, using it to transmit digital images of wounds and skin lesions, X-rays, and electrocardiograms, thus allowing subsequent management to be informed by specialist advice.</p> <p><i>Clinical management coordination: adequate follow-up between levels</i> Email was identified as a facilitator in accurate communication. Email may help avoid unnecessary referral.</p>
Electronic consultations via EHR							
Strauss SG, 2011	Community Oriented Primary Care (COPC) clinic, and two San Francisco Community Clinic Consortium clinics (USA)	Implementation of an electronic referral system (eReferral) to allow PC providers and specialists to communicate	Qualitative	Semi-structured interviews	Staff from 4 PC centres and 3 SC services (nephrology, cardiology, endocrinology)	<p><i>Clinical management coordination: consistency between levels</i></p> <p><i>Clinical management coordination: consistency between levels</i> impact on communication and coordination</p>	<p><i>Clinical management coordination: consistency between levels</i> eReferrals helped co-management by providing PCPs with support for patients who would not see a specialist or in cases in which the reviewer determined that the patient did not need to be seen in specialty care.</p>
Hysong SJ, 2011	Veterans Affairs Health Care System (USA)	Evaluation of barriers, facilitators, and suggestions for improving communication and coordination of EHR-based referrals in an integrated healthcare system	Qualitative	Semi-structured interviews and focus groups	Seven experts and six focus groups with a total of 30 PCPs and subspecialists at two tertiary care departments of Veterans Affairs medical centres	<p><i>Clinical information coordination between levels of care: transfer</i></p> <p><i>Clinical management coordination: adequate follow-up between levels</i></p> <p>barriers to and facilitators of the e-referral process</p>	<p><i>Clinical information coordination between levels of care: transfer</i> PCPs and subspecialists believed that insufficient information in e-referral requests was a major reason for discontinuation of use. PCPs and subspecialists disagreed on what they considered adequate content and ideal procedures for a referral request.</p> <p><i>Clinical management coordination: adequate follow-up between levels</i> PCPs and subspecialists disagreed over who was responsible for patient follow-up and PCPs identified a lack of robust referral-tracking mechanisms as a major barrier.</p>

(continued)

Table 2. Continued.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Rodriguez K, 2015	Veterans Affairs Health Care System, Pittsburgh (USA)	Implementation of an e-consult process to enhance communications between PCPs and specialists	Qualitative	Semi-structured interviews	Veteran patients (N = 15), Community Based Outpatient Clinic (CBOC) PCPs (N = 15), and VA Pittsburgh specialty physicians (N = 4)	<p><i>Clinical information coordination between levels of care: transfer experience of use</i></p> <p><i>Clinical management coordination: adequate follow-up between levels appropriateness of consultation</i></p> <p><i>Clinical management coordination: accessibility between levels access to specialty care</i></p>	<p><i>Clinical information coordination between levels of care: transfer:</i> E-consults improved communication including effective information transfer, decision-making processes, and a patient-centred approach to care.</p> <p><i>Clinical management coordination: adequate follow-up between levels</i> PCPs and specialty providers were confident about the appropriateness of case for e-consult.</p> <p><i>Clinical management coordination: accessibility between levels</i></p> <p>All participants were satisfied with the improved access to specialty care provided through e-consult.</p>
Gupte G, 2016	Veterans Affairs Health Care System, Boston (USA)	Implementation of electronic consultations (eConsults) in a large Veterans Affairs healthcare system	Mixed-methods	Semi-structured interviews with a sample of clinicians and hospital leaders	17 PCPs, 9 nurses, 1 pharmacist, and 4 hospital leaders (including 2 chiefs of specialties) and providers from 21 specialties	<p><i>Clinical management coordination: consistency of care between levels</i></p> <p><i>adequate follow-up between levels</i></p> <p>benefits of concerns about implementation and workload</p>	<p><i>Clinical management coordination: consistency of care between levels</i></p> <p>Most PCPs and specialists perceived that resulted in more efficient medication management and expedited diagnostic testing in lieu of or in preparation for a specialty visit because of a more effective communication with specialists.</p> <p><i>Clinical management coordination: adequate follow-up between levels</i> Some specialists thought that PCPs e-consults were inadequate, due to a lack of clinical confidence, and created excess and unwelcome work for some consultants.</p>
Anderson E, 2021	Veterans Affairs Health Care System, New England (USA)	Evaluation of an electronic consultation system to enhance communications between PCPs and specialists	Qualitative	Semi-structured interviews	25 PCPs, 35 specialists, and 13 clinical leaders of 6 sites of the Veterans Integrated Service Network	<p><i>Clinical information coordination: transfer</i></p> <p><i>Clinical management coordination: adequate follow-up between levels</i></p> <p>consistency of care between levels participants' perspectives on the role and impact of electronic consultations on communication and relationships between clinicians</p>	<p><i>Clinical information coordination between levels of care: transfer:</i> electronic consultations were widely viewed as a superior mechanism for unidirectional transfer of information between providers (consultation) but have limited usefulness for shared clinical deliberation.</p> <p><i>Clinical management coordination: adequate follow-up between levels</i> One prominent issue was a perceived gap in follow-up (closed-loop) communication after an electronic consultation is completed.</p> <p><i>Clinical management coordination: consistency of care between levels</i> Clinicians felt that electronic consultations have limited usefulness for shared clinical deliberation.</p>

(continued)

Table 2. Continued.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Liddy C, 2015	Champlain Local Health Integration Network, Ontario (Canada)	Evaluation of the Champlain BASE (Building Access to Specialists through eConsultation) service between PCPs and specialists	Mixed-methods	Thematic analysis of open-ended questions of a survey of PCPs after the electronic consultations with specialists between 15th April 2011, and 31st December 2013	559 written comments reported from 137 different PCPs	<i>Clinical management coordination: adequate follow-up between levels</i> benefits for the quality of patient care, reassurance of the PCP, attitudes towards using electronic consultations	<i>Clinical management coordination: adequate follow-up between levels</i> Many PCPs expressed how helpful it was to receive a quick answer. PCPs recognized that specialist appointments can place a significant burden on some patients and using electronic consultations will avoid unnecessary referrals.
Helmer-Smith M, 2020	Champlain Local Health Integration Network, Ontario (Canada)	Evaluation of the Champlain BASE (Building Access to Specialists through eConsultation) service between PCPs and specialists in long-term care homes	Mixed-methods	4 focus groups with PCPs, senior leadership, and one nurse	10 PCPs, 4 administrators, and 1 nurse	<i>Clinical management coordination: adequate follow-up between levels</i> perspectives of early adopting PCPs on the use of eConsultation in long-term care centres	<i>Clinical management coordination: adequate follow-up between levels</i> Participants reported that it increased their confidence in their course of action. In addition, PCPs reported that eConsultation avoid unnecessary resident transfers to external appointments. Participants also reported that allow them to seek advice on a resident's condition when they may not have otherwise.
Hensel J, 2018	Ontario (Canada)	Implementation of 2 e-consult platforms (one private and one government-funded) between PCPs and psychiatrists	Mixed-methods	1 individual semi-structured interview and 3 focus groups with PCPs	10 PCPs	<i>Clinical information coordination between levels of care: transfer</i> <i>Clinical management coordination: adequate follow-up between levels</i> explored the PCPs' perceptions of the uses and barriers of e-consults with psychiatry	<i>Clinical information coordination between levels of care: transfer</i> The PCPs viewed as a potential tool for shared care of patients by functioning as means of communication between providers to facilitate 'collaboration' rather than 'consultation' to bring providers 'together with the best plan'. <i>Clinical management coordination: adequate follow-up between levels: consultants</i> frequently suggested or attached provider and patient resources, which often included e-resources.
Lee M, 2018	Los Angeles County Department of Health Services (USA)	Introduction of an eConsult programme between PCPs and specialists	Qualitative	Semi-structured interviews	40 PCPs	<i>Clinical management coordination between levels of care: adequate follow-up between levels, accessibility between levels, consistency between levels</i> perceptions of the results of eConsult, including positive and negative themes and remaining perceived gaps in specialty care	<i>Clinical management coordination: adequate follow-up between levels</i> Positive perceptions: improved timeliness, reduced unnecessary visits, increased comfort management. Negative perceptions: lack of follow-up after eConsult. <i>Clinical management coordination: accessibility between levels</i> Some believed that patients received in-person visits more quickly through eConsult and some believed that they were an obstruction that slowed access to care because of the interactive nature of the eConsult approach to referrals. <i>Clinical management coordination: consistency</i>

(continued)

Table 2. Continued.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Rea CJ, 2018	Boston Children's Hospital primary care clinic (USA)	Implementation of a consultation and referral system within the EHR (shared care) between PCP and specialists (neurology and gastroenterology)	Mixed-methods	Thematic analysis of open-ended questions posed to PCPs and specialists	65 PCPs, 16 specialists	<p><i>Clinical information coordination between levels of care: transfer</i></p> <p><i>Clinical management coordination: adequate follow-up between levels</i> benefits of concerns about implementation</p>	<p><i>between levels</i></p> <p>Negative: lack of trust with the specialists, increased burden of pre-referral workup, expected practices do not help the referral process.</p> <p><i>Clinical information coordination between levels of care: transfer</i> Most PCPs said that shared care facilitated better communication with specialists. The biggest barriers reported included not receiving enough information in consultations. <i>Clinical management coordination: adequate follow-up between levels</i> Enabling management of patients within PC without need for referral and encouraging more comprehensive evaluations before specialty referral; facilitating appropriate triaging of referrals.</p>
Rankine J, 2021	Children's Hospital of Pittsburgh, Pittsburgh (USA)	Implementation of an e-consult prototype between general paediatricians and adolescent medicine specialist	Qualitative	Semi-structured interviews and think-aloud feedback	12 general paediatricians and 12 specialists	<p><i>Clinical information coordination between levels of care: transfer</i></p> <p><i>Clinical management coordination between levels of care: consistency of care</i></p> <p>Usefulness and complexity; duplication of information</p> <p><i>Clinical management coordination between levels of care: accessibility between levels</i></p>	<p><i>Clinical information coordination between levels of care: transfer</i> general paediatricians and specialists said that it facilitates communication with a specialist in a more structured way</p> <p><i>Clinical management coordination between levels of care: consistency of care</i> general paediatricians raised concerns about duplicating their work.</p> <p><i>Clinical management coordination between levels of care: accessibility between levels</i> both levels expressed improving access to care, increasing timeliness, and convenience of care, reducing travel burden for patients.</p>
Job, 2022	Western Queensland Primary Health Network (WOPHN), Brisbane South Primary Health Network (BSPHN), Mater Hospital Brisbane (Australia)	Implementation of an e-consult process to enhance communications between PCPs and specialists	Mixed-methods	Semi-structured interviews	11 PCPs, 4 other stakeholders	<p><i>Clinical management coordination between levels of care: accessibility between levels</i></p> <p>enablers and barriers in the of e-consults implementation</p>	<p>Participants emphasized e-Consult is an efficient service, which PCPs report as easy to use. Timeliness of the specialist's response in comparison to traditional outpatient referrals was mentioned by most participants.</p>
Bifulco, 2023	Federally Qualified Health Centers, Texas (USA)	Implementation of a web-based electronic consultation (eConsult) platform for several specialties	Mixed-methods	Semi-structured interviews	9 PCPs	<p><i>Clinical management coordination: consistency between levels</i></p> <p>PCP doctors agree on the treatment goals and plans proposed by specialists.</p> <p><i>Clinical management coordination: adequate</i></p>	<p><i>Clinical management coordination: consistency between levels:</i> several PCPs described receiving eConsult recommendations that were medically appropriate but impracticable for their</p>

(continued)

Table 2. Continued.

First author, year	Study area	Intervention	Type of study	Data collection	Study population/sample	Outcomes	Main results
Peeters K, 2023	Zuyderland Medical Centre, Sittard-Geleen (Netherlands)	Implementation of a referral application ZorgDomein (ZorgDomein)	Qualitative	Semi-structured interviews	15 general practitioners (GP) and 17 hospital specialists	<p><i>Follow-up between levels</i> Ability and willingness</p> <p><i>Clinical information coordination between levels of care: transfer</i> Communication <i>Clinical management coordination: adequate follow-up between levels</i> Quality of questions and response, avoidance of unnecessary referrals <i>Clinical management coordination between levels of care: accessibility between levels</i> Access to care</p>	<p>low-income, uninsured patients and that was the primary reason for not applying the recommendations made. But others expressed that specialists' responses did not always address their clinical question. <i>Clinical management coordination: adequate follow-up between levels</i> PCPs noted the ease of using eConsults to help patients avoid face-to-face referrals.</p> <p><i>Clinical information coordination between levels of care: transfer</i> Both GPs and hospital specialists agreed that owing to the asynchronous nature of e-consultation, communication has become more efficient. But communication is more impersonal owing to the unidirectional nature. <i>Clinical management coordination: adequate follow-up between levels</i> GPs appreciate hospital specialists offering clear and elaborate diagnostic and therapeutic guidelines for different possible situation. GPs and hospital specialists acknowledge of an e-consultation to avoid a referral to the hospital, especially for older patients. <i>Clinical management coordination between levels of care: accessibility between levels</i> Both GPs and hospital specialists recognized the increased accessibility to specialized hospital care through e-consultations.</p>

ICT: information and communication technologies; CC: clinical coordination; PCP: primary care physician; EHR: electronic health record; PC: primary care; SC: secondary care.

on specific dimensions of clinical management coordination, mainly follow-up and accessibility of care between levels. The growing interest in assessing their contribution to these dimensions may be driven, among other factors, by the need to reduce waiting times for SC appointments and unnecessary referrals, both of which are seen as key performance indicators in evaluating quality of care.⁶⁹ To a lesser extent, the impact on information transfer and consistency of care between levels (such as test duplication and joint treatment decisions) was evaluated, particularly in qualitative studies. These dimensions require equal attention, as some of the studies showed that health professionals report worse experiences in these areas,^{70–72} and that coordination mechanisms which facilitate greater interaction, direct communication, and feedback among professionals can improve clinical coordination between levels.^{4,70,73}

Electronic consultations via EHR are useful for improving clinical coordination but come with limitations

While quantitative studies highlighted positive impacts of implementing electronic consultations via EHR on certain dimensions of clinical coordination between levels, qualitative studies revealed potential risks associated with their implementation. Overall, the quantitative results consistently demonstrated improvements in patient follow-up between levels, specifically in terms of enhancing the clinical appropriateness of referrals, and recommendations from SC to PC doctors. These findings are important as inappropriate referrals incur unnecessary direct costs for the healthcare systems (productivity, etc.) and indirect costs for patients (time, travel).^{74,75} Moreover, the increase in treatment recommendations and follow-up reported by PC doctors can be crucial for enhancing their skills and confidence in managing patients,⁴⁷ reducing inappropriate and unnecessary referrals, and strengthening trust among professionals across different levels of care.^{5,72} However, some qualitative studies indicated that due to their asynchronous nature, electronic consultations were perceived by PC doctors as a one-way communication system that limits joint decision-making in patient management^{48,61} and may lead to mistrust in the recommendations received from specialists.⁴⁹ Further exploration is needed to better understand the impact of their implementation on information coordination, going beyond mere information transfer and into greater depth on the nature, usefulness, and utilization of shared information, as well as how it affects the way in which communication between SC and PC is perceived.⁴⁹

Furthermore, the majority of quantitative studies consistently highlighted the positive impact of electronic consultations on improving accessibility between levels,

when compared to other alternatives such as traditional or paper-based referrals, as evidenced by reduced specialist response times and waiting times for appointments with specialists. Although qualitative studies also reported this,^{26,29} some did not detect any improvements, such as in psychiatry³⁹ or neurology.⁴¹ This may be due to the different coordination needs of each specialty, which may determine the level of utilization of the mechanism and therefore its impact,⁷¹ or to organizational factors such as unresolved staff shortages (resulting in long waiting lists in many healthcare systems) that may hinder the impact in these specialties.²⁹ The qualitative studies also identified other issues, such as incomplete or inadequate transfer of information,^{41,50,51} or an increase in requests for further information/tests prior to accepting a referral, which could restrict accessibility²⁹ or lead to test duplication, treatment contradictions or duplications, and increased healthcare costs.¹⁹ Further study is therefore needed to explore the impact on other dimensions of management coordination, such as consistency of care between levels.

Limited evidence of the impact of other ICT-based mechanisms on clinical coordination

The number of studies examining the impact of shared EHR on clinical coordination between care levels is notably low, despite their widespread implementation in most healthcare systems.²¹ The two studies found evaluated the impact on one dimension of clinical coordination (transfer of information and consistency of care between levels) and showed an increase in timely access to clinical information and a reduction in test duplication, in keeping with the perceived potential benefits of implementing this mechanism.^{9,22} Evaluations regarding its impact may be scarce because it was developed as a technological solution to streamline the high volumes of paper-based information in hospitals,⁷⁶ and studies predominantly focused on barriers, facilitators, or the impact of EHR use within a single level of care.²²

Studies on the impact of email consultations on clinical coordination between levels are also limited in number, possibly due to the security and privacy issues associated with patient information, which began to discourage their implementation.⁷⁷ Moreover, the rise of electronic consultations via EHR may have contributed, as it offers the advantage of being linked to a secure platform with access to comprehensive patient information. Further studies are needed to analyse the impact of other ICT-based coordination mechanisms, such as videoconference case discussion sessions between levels which – as a synchronous mechanism – can not only enhance clinical skills but also promote knowledge exchange among professionals and thus improve coordination between levels,⁵ or instant messaging applications like WhatsApp®, which can be useful

in facilitating information exchange and supporting clinical decision-making.⁷⁸

Although a rigorous method was used for the search, this review has some limitations. Firstly, the studies found are highly diverse in terms of methodology, context, and focus, which limits their comparability. Therefore, the results regarding the impact of mechanisms on clinical coordination should be interpreted with caution. Secondly, this review used a conceptual framework for clinical coordination between levels,³² and it is possible that some articles evaluating aspects of coordination not explicitly included in the framework may have been omitted. However, it is worth noting that this conceptual framework was developed based on an extensive literature review and provides a comprehensive analysis of clinical coordination, taking into consideration its different types and dimensions.³² Finally, there may be publication bias as only original scientific articles were considered, and grey literature, which could be a potential source of negative or neutral results,⁷⁹ was not included. Despite the abovementioned limitations, this study provides an initial insight into the impact of ICT-based mechanisms on clinical coordination between healthcare professionals from different levels and identifies gaps in knowledge.

Conclusions

This scoping review has brought together the currently available scientific evidence regarding the impact of ICT-based coordination mechanisms on clinical coordination between PC and SC doctors, using a comprehensive conceptual framework. It has also identified existing gaps in the literature. In general, the evidence is limited and primarily focuses on the impact of electronic consultations via EHR. Moreover, the studies come from high-income countries, which may restrict the applicability of the results to other contexts.

The results of the studies were generally consistent in reporting a positive impact of electronic consultations on specific aspects such as the appropriateness of referrals and accessibility of SC. However, there was no evaluation of their impact on care consistency between levels, despite its importance for the quality and efficiency of healthcare systems. Nevertheless, qualitative studies highlighted potential negative effects on coordinated care and accessibility between levels. Further research is needed to delve into these areas. Lastly, despite the growing popularity of mobile applications or videoconferences as strategies to improve communication among health professionals, there is a lack of studies evaluating their impact on clinical coordination. It is therefore essential to promote rigorous evaluation of the implementation of these mechanisms to inform policies and strategies aimed at improving coordination between care levels, thereby contributing to high-quality and efficient healthcare delivery.

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