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Accountable Referral Coordination under Changing Digital Capabilities

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ABSTRACT: Digital referral systems may transfer information correctly while leaving unfinished work without clear ownership. This conceptual study asks how referral accountability should be preserved when the usable digital capability of a participating organisation changes before an episode is closed. A targeted critical synthesis of coordination theory, referral research and healthcare interoperability standards was used to define the problem and examine its boundaries. The analysis produced an obligation record and eight decision rules that separate delivery, acceptance, completion and reconciliation evidence; preserve operational custody during route changes; and distinguish workflow custody from clinical responsibility. Minimum evidence requirements and implementation duties make the rules explicit. Four hypothetical walkthroughs examine an interface outage, contradictory updates, exhausted assisted capacity and patient withdrawal. Five propositions set out expected mechanisms, boundary conditions and future tests. The model does not propose a new exchange standard. It specifies governance rules that can work with existing interoperability components when referrals move between integrated, portal and assisted communication. No software, patient data or empirical outcomes are reported. The model's feasibility and effect on service performance require prospective evaluation.

1. INTRODUCTION

A referral can be transmitted successfully and still remain operationally unresolved. For example, a referring clinic may receive a delivery confirmation, yet the specialist service may lose portal access before accepting the work. A coordinator may then switch to telephone contact, and a later electronic update may report completion even though the referring clinic has not received an interpretable outcome. The communication route has changed, but the obligation has not necessarily been resolved.

Referral research already identifies workflow and information barriers across organisations (McCormack et al., 2024). Guidance from the Institute for Healthcare Improvement and National Patient Safety Foundation (IHI/NPSF, 2017) stresses following referrals through to a meaningful outcome. Health Level Seven (HL7) Fast Healthcare Interoperability Resources (FHIR) provides resources for service requests, tasks, provenance and audit. The HL7 Social Determinants of Health (SDOH) Clinical

Care implementation guide describes direct and intermediary-supported referral configurations (HL7 International, 2019a-e; 2026). Task ownership, referral intermediaries and unequal digital capability are therefore established ideas.

The narrower problem considered here arises when the usable coordination route changes during an active episode. A route change can alter what evidence is available, who can act and how progress is interpreted. If delivery, acceptance, completion and closure are treated as the same event, unfinished work can disappear from view. The proposed model therefore separates reported service status from the evidence needed to resolve an obligation. It also separates operational custody of follow-up from clinical responsibility.

The paper makes three analytical contributions. It specifies the information that should survive a capability transition, defines rules for accepting and transferring operational custody, and develops propositions linking capability change, evidence requirements and coordination capacity. The contribution is deliberately bounded. No software was developed, no patient data were used and no improvement in clinical or service outcomes is claimed. The study therefore asks: how can referral services preserve accountable follow-up when a participating organisation's usable digital capability changes before the referral is resolved?

2. MATERIALS AND METHODS

2.1 Conceptual approach and source selection

The paper uses a targeted critical synthesis to develop a conceptual model. Jaakkola (2020) distinguishes several forms of conceptual research and emphasises explicit choices about the role of theory. Here, coordination theory supplies the analytical lens. Referral research establishes the problem context. Standards specify existing technical possibilities and constrain originality claims. These sources are used for different purposes, rather than treated as interchangeable evidence of effectiveness.

The source check was completed on 7 October 2026. Web searches combined healthcare, referral, accountability, capability, workflow and FHIR Task. Further searches used exact titles to verify relevant publications. Primary materials were retrieved from journal and publisher websites, PubMed and PubMed Central, an author-hosted paper, HL7 and IHI. The search included the phrase combination "capability adaptive healthcare referral accountability handoff conceptual framework FHIR Task". A broader query combined "healthcare", "referral", "accountability", "capability" and "workflow". Reference checking then focused on close conceptual and technical alternatives. Cited standards and bibliographic details were rechecked during final revision on 21 October 2026; this was source verification rather than a new systematic search.

Sources were retained when they helped establish a referral coordination problem, explain an organisational mechanism or specify an existing referral capability. Product promotion and generic architecture descriptions were not used as evidence of novelty. Foundational theory was retained regardless of age. Recent standards were version-specific. This is not a systematic review, a bibliometric study or a Scopus database search. No exhaustive retrieval count, duplicate-screening procedure or independent reviewer agreement is claimed. Accessible abstracts were used conservatively when full-text access was incomplete. Table 1 identifies the main comparators and their role in the argument.

2.2 Analytical procedure

The synthesis proceeded through three analytical questions. What does each source already explain or support? What decision remains when a communication route fails or becomes unusable? What information would be required to make that decision without confusing uncertainty with completion? These questions led to a narrower focus on capability transitions within an episode. The resulting model was then examined through deliberately contrasting hypothetical sequences. Each sequence changes a stated condition and traces the consequences of the rules.

The comparison is critical rather than additive. A feature was not treated as new merely because it received a new name. Existing support for task ownership, intermediary workflows and completion reporting was recognised explicitly. Proposed additions were framed as local governance rules, not missing FHIR primitives. The analysis also considered a strong alternative: a well-configured existing referral service may already implement all of the proposed safeguards. In that case, the model provides an explicit explanation and evaluation structure, rather than an additional technology.

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3. RESULTS AND DISCUSSION

3.1 Literature context and bounded research gap

3.1.1 Dependencies and organisational context

Malone and Crowston (1994) analyse coordination through dependencies between activities. This lens directs attention to what one organisation needs from another before work can proceed. In the present model, those dependencies include an accepted task, access to appropriate information and an interpretable response. A dependency can remain unresolved even when a message has been delivered. The proposed contribution concerns how that unresolved dependency is represented through a change in communication route.

Digital capability also depends on organisational conditions. Greenhalgh et al. (2017) connect technology adoption and sustainability with interacting clinical, organisational and wider contextual factors. Huettemann et al. (2024) develop a digital health ecosystem taxonomy that includes organisational and technical capabilities. Together, these perspectives caution against classifying a provider solely by whether it exposes an application programming interface. A technically connected organisation may have no available staff to accept a referral. Another may lack a server while maintaining a reliable, authorised coordination service.

Governance research provides a further constraint. Chiba et al. (2024) identify inter-organisational, legal and standardisation factors in electronic health record interoperability. Enam et al. (2022) argue for more explicit mechanisms and contextual explanations when linking information technology with healthcare performance. The present paper therefore avoids an unsupported chain from greater connectivity to better outcomes. Its propositions identify intermediate changes in visibility, responsibility and reconciliation. Whether those changes improve patient experience or service timeliness remains an empirical question.

3.1.2 What existing standards already provide

FHIR Task represents work and its lifecycle, including ownership and associated inputs or outputs (HL7 International, 2019a). ServiceRequest represents a request for a healthcare service (HL7 International, 2019b). These resources already make it possible to separate a request from the work undertaken to fulfil it. The proposed model uses that distinction. It does not introduce a competing task lifecycle or redefine standard status codes.

The Social Determinants of Health Clinical Care guide is the closest technical comparator. It supports referral sources, recipients and intermediaries with different FHIR capabilities. It also includes acceptance, progress and completion exchanges (HL7 International, 2026). This directly challenges a broad claim that heterogeneous referral orchestration is new. The paper's narrower focus is the continuity of unresolved obligations when an active episode changes route, together with the effect of that change on evidence and human workload. It does not assert that all existing implementations lack these controls. The guide is designed for the United States social-care context; using its interaction patterns as comparators does not establish compliance in other settings.

Provenance and AuditEvent provide further building blocks. Provenance describes the origins and agents associated with resource creation or transformation. AuditEvent supports recording events relevant to security and operational audit (HL7 International, 2019c; 2019d). Neither should be treated as automatic proof that the described care occurred. A properly attributed record can still be mistaken. Consent representation also does not itself enforce an access decision; implementation and policy remain necessary (HL7 International, 2019e).

3.1.3 Gap addressed in this study

The selected literature supports a bounded design question: how should a referral service relate changing execution capability to the evidence and custody needed for each outstanding obligation? The gap is an analytical separation across the materials examined, not demonstrated universal absence. The proposed synthesis joins capability transitions, responsibility continuity and closure assessment at the handoff level. Its potential value lies in making the relationship explicit enough to challenge and test.

The model must explain why a route change creates a specific uncertainty, which rule addresses it, and when that rule becomes costly or unnecessary. Table 1 separates inherited elements from the question pursued here. Claims of priority would require a broader, reproducible search and comparison with operational referral systems.

Table 1. Main comparators and the bounded contribution

Comparator	Established contribution	Question pursued in this paper
Malone and Crowston (1994)	Dependencies as a basis for analysing coordination.	What obligation survives a change in its communication route?
IHI/NPSF (2017); McCormack et al. (2024)	Closed-loop referrals and cross-institutional workflow problems.	What evidence resolves a handoff after conflicting updates?
Huettemann et al. (2024); Greenhalgh et al. (2017)	Capabilities and the organisational context of digital health.	How does capability changing within an episode affect custody?
HL7 International (2019a; 2026)	Task lifecycles and heterogeneous referral configurations.	Which local rules preserve obligations during route transitions?
Enam et al. (2022); Chiba et al. (2024)	Mechanisms, context and interoperability governance.	When do explicit rules improve coordination, and when do they add burden?

3.2 Proposed model of accountable coordination

3.2.1 Scope and constructs

The model assumes a network with an agreed governance process and an identifiable originating service. It applies to planned referrals that permit monitored follow-up. Emergency pathways require separate clinical procedures. The network must specify who can request, accept, delegate and reconcile work. Without that authority structure, an additional record cannot create accountability. The model also assumes access to at least one authorised communication route. Where no route exists, it exposes an unresolved service problem rather than claiming to solve it.

A referral episode is the parent coordination object. It can contain several obligations, such as accepting the request, arranging contact, returning an outcome and deciding what follow-up remains. These obligations are not identical to clinical treatments. Each has a defined purpose and resolution condition. Their separation prevents one successful action, such as booking an appointment, from closing every downstream dependency. A clinically appropriate cancellation can resolve an obligation without representing successful service delivery.

Capability means the presently usable ability to perform a specified coordination action through an authorised route. It includes technical access, authority to act, operational availability and ability to return interpretable evidence. Capability is therefore assessed for a task and a time, rather than assigned as a permanent maturity label. The assessment records its source and age. A self-declared capability can be useful but should not be mistaken for observed availability. Unknown capability remains unknown until an appropriate check is completed.

Operational custody is the duty to pursue or escalate the next unresolved coordination step. It can be held by a team if the team has a monitored queue and an accountable role. Clinical responsibility concerns decisions about care and cannot be transferred merely by editing a workflow field. A coordinator may hold custody of an unanswered referral while the referring clinician retains the relevant clinical responsibilities. Organisations must agree the relationship between these roles before using the model. The accepted service provider and the custodian of administrative follow-up can therefore differ; both must be identifiable for their respective scopes.

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3.2.2 Obligation record

The proposed obligation record links the episode identifier to a specific requested action, current custodian and resolution criterion. It also records the receiving party, acceptance evidence, route, relevant policy context, review deadline and escalation destination. Evidence entries identify the reporting actor, the event described and when that event was reported. Table 2 gives the minimum conceptual fields. This is a design specification, not an implemented data schema or a new interoperability standard.

Four evidential distinctions are central. Delivery concerns receipt, acceptance concerns agreement to specified work, completion concerns the action reportedly performed, and reconciliation concerns an authorised decision about resolution. These are separate assessments, not compulsory sequential states or replacements for standard status codes. One attributable event can support more than one assessment if its meaning and authority are explicit.

Evidence requirements concern content and authority, rather than document counts. Repeated copies of one message are not independent confirmations, and a transport acknowledgement cannot satisfy a clinical interpretation requirement. Networks should specify proportionate requirements for each obligation and permitted disposition, avoiding unnecessary forms or duplicate records.

The record preserves a distinction between event time, receipt time and reconciliation time. A late message may describe an earlier event. Its arrival order should not determine clinical or operational truth. Corrections should retain links to the superseded account and the reason for correction, subject to applicable record-management rules. This does not imply an immutable ledger. The objective is understandable traceability, with appropriate access and retention, rather than indefinite storage of every detail.

Table 2. Proposed minimum obligation record

Information group	Proposed content
Identity and purpose	Episode, subject and obligation references; requested action; receiving actor; related obligations.
Custody and authority	Current custodian; accepted scope; proposed successor; transfer status; acceptance basis and effective time.
Resolution criterion	Permitted dispositions; required evidence; authorised assessor; parent closure dependencies.
Capability and route	Route; capability observations and source; observation age; assisted capacity; reassessment reason.
Time and escalation	Original and current deadlines; escalation role and response expectation; reasons for deadline revisions.
Evidence and provenance	Reporter and recorder; authority; event and receipt times; supporting record reference and version.
Policy context	Access and sharing basis; relevant restrictions; applicable policy version.
Reconciliation and history	Assessor; decision time; criterion version; disposition; conflicts; linked corrections, transfers and route episodes.

3.2.3 Minimum evidence for referral assessments

Table 3 specifies minimum content for the four assessments. The same content is required across integrated, portal and assisted routes, although its representation can differ. An assisted entry identifies both the source and the recorder, the identity-check method and any limitation on verification; recording a statement does not convert it into an independently verified outcome.

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Table 3. Minimum evidence for the four referral assessments

Assessment	Minimum attributable content	Permitted interpretation
Delivery	Linked message or obligation; intended endpoint or verified recipient; receipt time; acknowledgement source.	Receipt only. Identify whether acknowledgement came from a system or a person.
Acceptance	Linked obligation; authorised accepting actor or applicable standing agreement; accepted scope; effective time; explicit custody terms.	Work accepted within scope. Custody changes only when the agreement includes that duty.
Reported completion	Linked action; reporting actor and authority; event time; action and outcome reported; required supporting result reference.	Action reported as performed. Missing or contradictory evidence still requires review.
Administrative reconciliation	Authorised assessor or approved rule; criterion and policy version; evidence references; decision time; disposition; treatment of conflicts and follow-up.	Obligation resolved administratively only when its criterion is met; this does not establish clinical resolution.

3.2.4 Routes and capability change

Three routes describe alternative means of carrying coordination evidence. An integrated route exchanges structured information between connected systems. A portal route allows an authorised participant to work through a shared interface without operating its own server. An assisted route allows a designated coordinator to record an authenticated interaction through an approved channel. These routes are analytical categories. They are not maturity scores, and no route is assumed to be intrinsically safer or faster.

Route selection first checks authorisation, identity and task suitability. It then considers usable connectivity, staff availability and the ability to produce the required evidence. If several routes meet the conditions, local service policy determines the choice using burden, accessibility and timeliness. If none meets them, the obligation stays unresolved and receives an escalation decision. The model deliberately avoids a weighted numerical score. Unsupported weights could conceal a failure of authority or confidentiality behind a high technical score.

A route change creates a new route episode within the same obligation. The prior evidence, unresolved requirements and current custodian remain linked. The reason and effective time of the change are recorded. Deadlines do not automatically restart. An authorised reviewer may revise them with a reason, but a technical outage should not make an overdue referral appear new. The new route must support the same meaning of resolution, even if the form of evidence differs.

The assisted route requires explicit limits. A coordinator records who supplied the information and what authority that person held. The coordinator does not impersonate the provider or silently convert a telephone statement into a provider-authored document. Access must remain restricted to necessary information. A route that depends on assistance also consumes staff capacity. When that capacity is unavailable, the service should expose the constraint and consider alternatives. An unstaffed fallback is not a functioning service.

3.2.5 Decision rules

Rule 1 Initiation. An active obligation requires a linked request, defined action, originating custodian and resolution criterion. Missing information creates a clarification task under originating custody; it does not justify dropping the request.

Rule 2 Acceptance. Delivery cannot establish acceptance. Evidence must identify the authorised accepting actor, scope and effective time, or the applicable standing agreement and satisfied conditions. Acceptance of clinical work does not by itself transfer administrative follow-up custody.

Rule 3 Custody continuity and transfer. The current custodian retains follow-up until an authorised successor accepts the specified custody duty or the obligation reaches a permitted disposition. Record both roles, scope, acceptance basis and effective time. An unconfirmed transfer is pending. Outage, rejection or silence does not automatically return custody to the originator. If the custodian cannot act, a pre-agreed backup may take effect under its standing acceptance conditions; record its basis and

effective time while preserving the previous assignment. Without an available authorised backup, expose the unavailable custody as an exception rather than claiming effective coverage.

Rule 4 Reconciliation and closure. Reported completion is assessed against the predefined criterion by an authorised reviewer or approved unambiguous administrative rule. Keep completion, cancellation and decline distinct. Close the parent episode only after required in-scope obligations are reconciled and continuing work outside that episode has a linked, accepted follow-up assignment. Administrative closure does not certify clinical resolution.

Rule 5 Exceptions and escalation. Record missing evidence, missed deadlines, revoked access, capacity failure or contradictory reports as linked exceptions. Identify the current custodian, trigger, next action, escalation role and response deadline. An escalation notice is neither accepted custody nor resolution; absent acceptance, existing custody remains visible.

Rule 6 Capability transitions. A route change preserves identifiers, unresolved requirements, evidence and custody history. Record its reason and effective time. Deadlines do not restart automatically. Different work or a replacement service may require a linked new obligation and an explicit disposition of the earlier one to prevent duplicate action.

Rule 7 Conflicting and late evidence. Retain attributable accounts and assign reconciliation to the designated reviewer. Investigate whether reports concern different actions or an explicit correction; arrival order alone is insufficient. Record the rationale and supporting evidence. Unresolved material conflict prevents uncontested closure. A material contradiction after closure creates a linked review obligation with a custodian and flags the earlier decision as contested.

Rule 8 Patient choice. Record the source, scope and time of refusal or withdrawal, using identity verification proportionate to the channel, and assign required communication or clinical follow-up. Distinguish refusal of care from withdrawal of a sharing permission. A declined disposition is neither successful treatment nor, by itself, service failure. Applicable policy governs further processing.

These rules are specification-level expectations, not formally proven software invariants. No model checker, conformance suite or distributed-system experiment was used. **Figure 1** summarises the decision relationships; Table 4 gives event consequences. The rules specify local governance arrangements and do not establish a legal transfer of clinical responsibility.

Table 4. Proposed responses to representative events

Event	Custody consequence	Closure consequence
Transport acknowledgement	Retain the current custodian.	Delivery alone establishes neither acceptance nor resolution.
Authorised acceptance	Transfer only the expressly accepted scope of custody; otherwise retain follow-up custody.	Other obligations remain open.
Unconfirmed transfer or rejection	Retain existing custody; record the pending or refused transfer and next action.	Silence or rejection cannot close the obligation.
Interface outage	Retain the last confirmed assignment; invoke an agreed backup if the custodian cannot act.	Use an authorised alternative route without resetting the deadline.
Completion report	Keep return and reconciliation obligations with their assigned custodians.	Assess required evidence before administrative closure.
Contradictory report	Assign a reconciliation or linked review obligation to an authorised role.	Keep material uncertainty visible; flag any prior closure as contested.
Missed deadline or capacity failure	Escalate to the specified role; retain custody pending accepted reassignment.	Escalation alone cannot resolve the obligation.
Patient declines service	Assign any required communication or care-planning follow-up.	Record a distinct declined disposition; do not label successful treatment.

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3.2.6 Standards alignment and implementation boundaries

An implementation could link a ServiceRequest to one or more Tasks, using Task.focus for the request and Task.output for reported results. Task.owner identifies a task owner; it does not alone evidence an agreed custody transfer or legal clinical responsibility. Table 5 maps existing building blocks to the proposed governance decisions. Local profiles, extensions or associated records must be selected and validated. The evidence assessments in Table 3 do not redefine Task.status or ServiceRequest.status, and no FHIR conformance is claimed.

The distinction between a service task and a closure obligation is particularly useful. A receiving provider might truthfully complete its task while the referring service still needs to interpret the returned outcome. The model should not overwrite the provider's statement merely to keep the overall episode open. Instead, a linked obligation records the remaining reconciliation work. This preserves local meanings while preventing premature parent-level closure. Where an existing implementation already does this, the model should map to that arrangement. Here, clinical resolution means an authorised clinical assessment that the referral-related concern has been addressed or has an appropriate continuing care plan. Administrative closure records completion of defined coordination duties; it cannot certify treatment effectiveness or disappearance of disease.

Duplicate and delayed messages create an additional implementation concern. Stable episode and obligation identifiers would support correlation. Retried messages should not create duplicate service requests when they describe the same action. However, correlation alone does not guarantee exactly-once clinical activity. A coordinator must still investigate uncertain duplication. The model also requires a policy for concurrent edits and unresolved conflicts. It does not claim that a shared database, event log or blockchain can determine which clinical account is correct.

Table 5. Candidate standards alignment requiring future validation

Concept	Existing building block	Governance boundary
Service request	FHIR ServiceRequest (2019b).	Keep the clinical request separate from administrative follow-up.
Work tracking	FHIR Task; focus, owner, output and linked Tasks (2019a).	Preserve lifecycle meanings; specify acceptance, custody transfer and closure criteria locally.
Evidence origin	FHIR Provenance (2019c).	Record source and transformation; attribution cannot establish clinical truth.
Access and event audit	FHIR AuditEvent (2019d).	Support audit of relevant events; retain a separate interpretable basis for the disposition.
Permission context	FHIR Consent where applicable (2019e).	Policy evaluation and enforcement remain implementation duties.
Additional governance information	Local profile, extension or associated record to be selected.	Define criterion versions, custody history and exceptions; validate profiles and terminology before conformance claims.

3.2.7 Implementation responsibilities audit and escalation

Table 6 assigns proposed duties to roles rather than job titles. One person may hold several authorised roles, but delegation requires a monitored queue, cover arrangements and authority to act. Each network must agree these duties before operational use.

Table 6. Proposed implementation responsibilities

Role	Duty and required accountability
Network governance lead	Approve custody agreements, resolution criteria, escalation paths, cover arrangements and review of burden.

Originating service	Create the obligation and resolution criterion; retain default custody until an accepted arrangement takes effect.
Receiving service	Confirm accepted scope, service status and any custody duty; provide attributable outcome information.
Operational custodian	Monitor unresolved work and deadlines; pursue evidence, seek alternatives and escalate exceptions.
Assisted coordinator	Verify the reporting source as required; record the interaction and its limitations; expose capacity constraints.
Reconciliation and clinical reviewers	Authorised reconciler records the administrative disposition; the relevant clinician assesses clinical meaning and follow-up.
Technical and audit leads	Maintain identifiers, access controls, version history and log integrity; support independent review without deciding clinical truth.

Auditability requires reconstructing why a decision was made. Record actor and authority, event and receipt times, before-and-after custody assignments, evidence references, criterion version, decision time and rationale. Link corrections to superseded accounts. Control concurrent updates so a stale edit cannot silently overwrite accepted custody or a contested disposition. Protect logs against unauthorised alteration and define access and retention. These are design requirements, not demonstrated properties of a system.

Escalation policy specifies a first responsible role, response interval and further authority when no response occurs. Intervals depend on clinical priority and local service agreements; no universal time threshold is proposed. The current custodian monitors the escalation until accepted reassignment or a recorded disposition. If that custodian is unavailable, the agreed backup role acts and records its authority. Worsening urgency requires the applicable clinical escalation pathway, outside the administrative model.

Assisted capacity includes available trained staff, authorised access, working hours and current backlog, not merely a telephone number. Networks should agree acceptance limits, funded cover and an alternative or escalation path. A capacity shortfall remains visible under existing custody. Different organisational resources therefore affect whether the route is feasible, and additional documentation must not shift coordination work onto patients.

3.3 Analytical walkthroughs

3.3.1 Outage during an accepted referral

Consider an invented referral from Clinic A to Diagnostic Service B. The requested service is non-emergency. Clinic A records the referral and the expected return information. Service B accepts the work through an integrated route. Later, its interface fails. A verified coordinator reaches Service B through an approved assisted route. The service confirms that the appointment remains scheduled. No measured times, real patients or observed outcomes are represented in this example.

Under the proposed rules, acceptance remains associated with Service B. The route change does not cancel the accepted work or restart the review deadline. The coordinator records the authenticated update and the source of the report. Operational follow-up custody follows the prior agreement unless a successor explicitly accepts it. Once the service reports completion, the return and reconciliation obligations remain open until their own criteria are met. The example shows continuity of meaning across routes, not evidence of faster care.

A delivery-only configuration could lose this distinction if it equated message success with responsibility transfer. A well-configured closed-loop system could already preserve it. The proposed model's contribution in the latter case is to identify which configuration rules matter and why. The comparison is therefore between specified governance arrangements, not between the model and an artificially weak version of FHIR.

3.3.2 Conflicting reports after a route change

Now suppose an assisted interaction reports that the patient did not attend. A delayed electronic update then reports completion. The model does not choose the electronic message because it arrived later or appears more structured. Both accounts remain attributable. The obligation enters reconciliation, and the designated reviewer determines whether they describe different appointments, a corrected status or an unresolved inconsistency.

If the receiving service supplies a corrected account, the reviewer links it to the earlier reports and records the disposition. If the conflict cannot be resolved, the episode remains visibly uncertain. This is a cost as well as a safeguard. Additional reconciliation can delay administrative closure and require staff time. The model is justified only if the value of identifying consequential uncertainty outweighs that burden. It cannot establish that balance through a hypothetical example.

3.3.3 Assisted capacity is exhausted

A third case assumes that the digital route is unavailable and the coordination team has no capacity to process further assisted referrals within the agreed review interval. A routing rule that always selects assistance would hide the shortage. The proposed rule instead records that no currently feasible route meets the service conditions. The active custodian must seek an authorised alternative, revise the plan with the relevant parties or escalate the unresolved capacity problem.

The model does not create an appointment, a trained coordinator or a replacement provider. It may initially reveal more unresolved work than the previous system reported. That increase should not automatically be interpreted as worse coordination. It may reflect improved visibility. Conversely, persistent visibility without action offers little practical benefit. Staffing and escalation authority therefore act as necessary conditions for the proposed mechanism to improve service performance.

3.3.4 Patient withdrawal and a simple-case counterexample

In a fourth invented case, a patient declines the offered referral. The service records the scope of that decision and routes any required follow-up to an authorised clinician. The appointment obligation may be resolved as declined, while a separate communication or care-planning obligation remains active. A withdrawal of permission for one data-sharing purpose must also be distinguished from refusal of care. The applicable policy determines what further processing is permitted. The model does not establish a universal legal basis.

A counterexample limits the model's expected value. Suppose two organisations already use reliable, shared workflows with clear ownership, reconciled outcomes and adequate staff. Capability remains stable throughout the episode. Adding a separate obligation form may duplicate information and increase work without improving decisions. A proportionate implementation would reuse existing records or refrain from adding a new layer. The model predicts its greatest potential value where capability changes create real uncertainty about outstanding work, not wherever healthcare data are exchanged.

3.4 Propositions and future evaluation

3.4.1 Proposed mechanisms

Proposition 1 concerns continuity of custody. For otherwise comparable referrals exposed to a route change, explicit continuity rules should reduce the time during which no participant recognises responsibility for follow-up. The mechanism is preservation of an accepted operational obligation while its communication channel changes. The proposition requires a monitored queue and an empowered custodian. It would be weakened if documented custody did not improve shared understanding, or if informal arrangements performed equally well with less burden.

Proposition 2 concerns premature closure. Separating reported completion from assessed resolution should reduce unsupported closures when delayed or contradictory updates occur. The mechanism is an evidential gate between a report and a parent-level closure decision. The expected advantage should be smaller when completion messages are already sufficient and consistently interpreted. A future study should examine false closures and unnecessarily delayed closures together. Preventing every closure is not a useful success criterion.

Proposition 3 concerns capability and workload. An assisted route should widen feasible participation only when authorised staff capacity can support its evidence requirements. As unresolved assisted work accumulates, additional routing through that channel may increase delay. This proposition rejects an unconditional inclusion benefit from human assistance. It would be challenged if a service maintained equivalent coordination without the expected staffing demand, or if the assessment of required capacity proved unrelated to actual workload.

Proposition 4 concerns evidential consistency. When multiple routes use the same resolution criteria, changing route should produce fewer differences in how equivalent outcomes are classified. The proposed mechanism is preservation of decision meaning across different forms of communication. This does not require identical documents. It requires comparable authority

and information. A future comparison should include cases in which the criterion itself is unsuitable, because a consistently applied poor rule can still produce systematically poor decisions.

Proposition 5 concerns proportionality. The benefit of explicit obligation tracking should increase with consequential capability instability, but diminish where existing coordination is reliable or the new documentation burden is excessive. This conditional relationship is more informative than a claim that additional tracking always helps. It would be weakened by evidence that benefits were uniform across stable and unstable settings, or that the supposed mechanism was actually explained by additional staffing rather than the model's rules.

3.4.2 Evaluation without software development

A first evaluation need not involve coding. An independently conducted structured walkthrough could ask referral coordinators, clinicians, interoperability specialists and patient representatives to interpret identical fictional cases under alternative rule sets. Participants could identify the current custodian, unresolved evidence and permitted next action. Disagreement would reveal ambiguity in the definitions. Such work would be new research involving participants and would require the relevant institutional review before recruitment. No such exercise has been conducted for this paper.

A second stage could compare the model with actual written referral procedures. The comparison should record where existing practices already satisfy the proposed rules and where the model adds unnecessary work. A deliberately strong comparator would use established closed-loop coordination and available standards appropriately. A weak baseline would exaggerate the contribution. Negative findings, including complete overlap with existing procedures, should be reported rather than treated as a reason to rename the model.

If later prospective evaluation becomes feasible, measures should include unresolved custody duration, independently assessed unsupported closure, reconciliation delay and staff effort. Unsupported closure lacks the locally required basis when reviewed; its denominator is the closed obligations examined. Assess unnecessarily delayed closure as well. Workload includes searching, contacting, recording and resolving conflicts. Report results by route, clinical priority and organisational capacity, with uncertainty and missing records explicit. A strong existing closed-loop workflow is the comparator; differences in staffing must be considered before attributing effects to the rules.

The evaluation should also distinguish service quality from record quality. A complete log does not prove that the patient received appropriate care. Patient experience, accessibility and clinically meaningful consequences require separate assessment. Increased detection of unresolved work may initially raise recorded exception rates. Analysts should therefore examine whether exceptions are resolved appropriately, not merely whether their number falls. These distinctions protect against a misleading claim of success based on cleaner administrative data alone.

3.5 Practical implications and limitations

3.5.1 Theoretical and practical implications

The proposed model places capability change inside the coordination episode. Its explanatory claim is that instability affects not only message exchange but also the evidence available for interpreting obligations. Custody continuity and explicit reconciliation may moderate that effect. Human capacity limits whether these rules can be enacted. This connects a technical event, such as loss of interface access, to an organisational mechanism and a conditional service outcome. The propositions specify where that explanation could fail.

For managers, the practical implication is to define responsibility before choosing additional platform features. A procurement specification could ask how an active referral is handled when a receiving organisation loses access, changes staff or disputes a completion report. The answer should identify the responsible role, retained evidence and unresolved work. A feature labelled "automatic escalation" is insufficient if no one is authorised or resourced to respond. Evaluation should examine the resulting work arrangement rather than the presence of the label.

For standards-oriented design, the implication is to preserve the distinction between exchanged resource states and local governance decisions. A network may adopt a shared closure policy while allowing organisations to use different technical routes. That policy must remain explicit, versioned and contestable. If participating organisations disagree about its meaning, a

common data format will not settle the disagreement. Implementation guides and local operating agreements would need to specify how evidence and authority are interpreted together.

The model also exposes a possible equity problem. Providers with fewer digital resources may receive more assisted work and more documentation demands. The service should not penalise those providers for using an approved route or shift coordination costs onto patients. Resource allocation should follow the work required to meet a common service obligation. Whether that allocation is sustainable depends on funding, staffing and governance. The paper proposes an issue for evaluation, not evidence that the framework reduces inequity.

3.5.2 Limitations

The literature selection is targeted and interpretive. It cannot establish that the proposed combination has never been described or implemented. Some supporting publications were accessible only through abstracts or publisher summaries. The standards mapping is conceptual and has not undergone expert conformance review. The hypothetical cases were constructed to examine the rules, so they may omit situations that practitioners would consider decisive. The model contains no empirical estimates of effect, cost or acceptance by users.

The governance assumptions are substantial. Parties must agree on identity, authority, custody and resolution criteria. A network with unresolved institutional conflict may be unable to implement those agreements. The model may also concentrate invisible work in coordination teams or encourage defensive documentation. Poorly designed evidence requirements could slow care, frustrate patients or make routine referrals unnecessarily complex. These possibilities require investigation alongside the expected benefits.

Finally, the model is limited to planned referral coordination. It does not establish emergency procedures, clinical safety certification, privacy compliance or legal transfer of responsibility. National and organisational requirements may alter the permitted routes and records. Further work should first test whether the constructs are understandable and distinct from existing practice. Only then would implementation and outcome evaluation justify stronger claims about utility or generalisability.

4. CONCLUSION

Referral coordination depends on a clear account of what remains to be done, who must pursue it and what evidence can close the obligation. The model developed here preserves that account when usable digital capability changes during an active referral. Its main contribution is the explicit link between capability transitions, continuity of operational custody and evidence-based closure. Existing standards already provide many of the technical building blocks; the additional rules are a governance proposal rather than a replacement standard. The model also defines testable propositions and clear failure cases. The next step is independent expert review followed by prospective evaluation of feasibility, workload, unsupported closure and coordination delay. Until such evidence is available, the model should be treated as a conceptual framework rather than a proven improvement in care.

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Author Contributions

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manuscript preparation and revision. All authors critically reviewed and approved the final manuscript and agree to be accountable for the work.

Conflict of Interest

The authors declare that there is no conflict of interest.

Ethics Statement

This manuscript presents a conceptual analysis based on published sources and hypothetical referral cases. No human participants, patient records, animal experiments or identifiable personal data were used.

Data Availability Statement

No new empirical dataset was generated or analysed for this conceptual study. The standards and publications used in the analysis are cited in the reference list.

Use of Generative AI and AI-Assisted Technologies

Generative AI was used for language editing.

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Figure legend

Figure 1. Proposed decision structure for route change and closure. Arrows describe decision relationships, not a complete executable state machine. Route changes and completion reports may occur in either order. Custody is retained unless an authorised successor accepts the defined duty. Closure refers to administrative reconciliation; material late contradictions trigger a linked review obligation and a contested-closure flag.

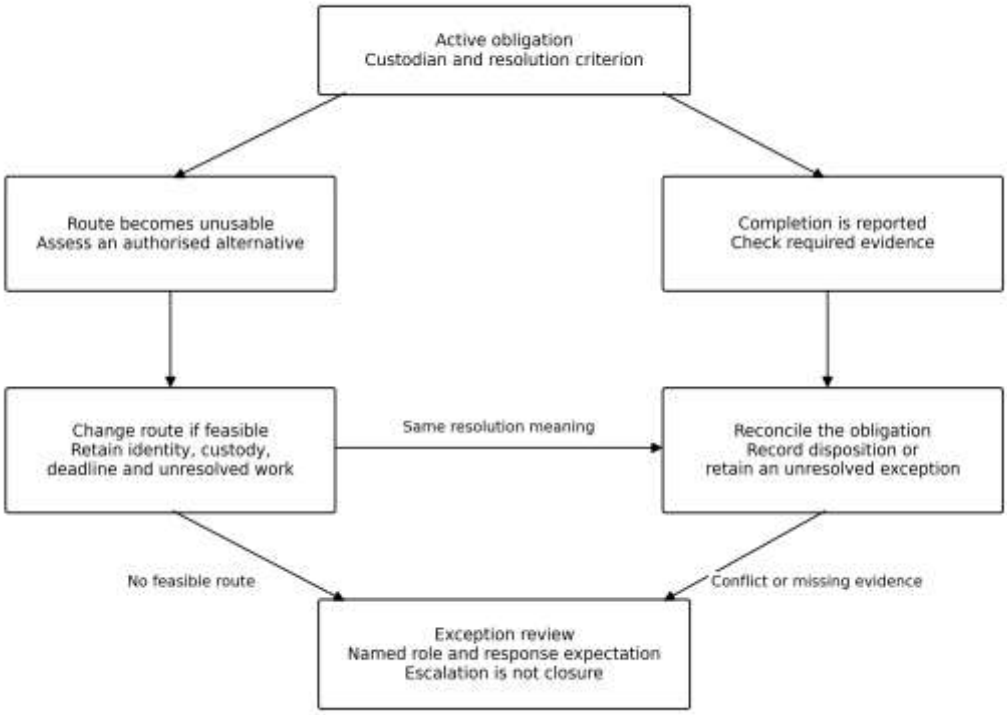


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