In person and virtual process mapping experiences to capture and explore variability in clinical practice: application to genetic referral pathways across seven Australian hospital networks

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ABSTRACT

Genetic referral for Lynch syndrome (LS) exemplifies complex clinical pathways. Identifying target behaviours (TBs) for change and associated barriers requires structured group consultation activities with busy clinicians – consolidating implementation activities whilst retaining rigour is crucial. This study aimed to: i) use process mapping to gain in-depth understandings of site-specific LS testing and referral practices in Australian hospitals and support identification of TBs for change, ii) explore if barriers to identified TBs could be identified through process mapping focus-group data, and iii) demonstrate pandemic-induced transition from in-person to virtual group interactive process mapping methods.

LS clinical stakeholders attended interactive in-person or virtual focus groups to develop site-specific "process maps" visually representing referral pathways. Content analysis of transcriptions informed site-specific process maps, then clinical audit data was compared to highlight TBs for change. TBs were reviewed in follow-up focus groups. Secondary thematic analysis explored barriers to identified TBs, coded against the Theoretical Domains Framework (TDF). The transition from in-person to pandemic-induced virtual group interactive process mapping methods was documented.

Process mapping highlighted six key areas of clinical practice variation across sites and site-specific TBs for change were identified. Key barriers to identified TBs emerged, categorised to seven TDF domains.

Process mapping revealed variations in clinical practices surrounding LS referral between sites. Incorporating qualitative perspectives enhances process mapping by facilitating identification of TBs for change and barriers, providing a pathway to developing targeted interventions. Virtual process mapping activities produced detailed data and enabled comprehensive map development.

Lay Summary

To achieve change in the health system using implementation approaches, time-poor clinicians must engage in information-gathering and idea-generation activities. This research revealed that qualitative process mapping focus groups held both in-person and virtually can be used to streamline these activities, by simultaneously identifying target behaviours for change, and barriers to change, while gaining information about site-specific clinical processes. Hospital process mapping shows that complex clinical processes vary significantly between sites, and that understanding local variation is crucial to developing targeted interventions. This study has informed new approaches to implementation research methods.

Keywords Implementation science, Lynch syndrome, Process mapping, Qualitative research, Focus-group research

BACKGROUND

Successful implementation of evidence-based health interventions requires an in-depth understanding of the systems and processes being targeted for change. In the hospital setting, patient diagnostic and referral pathways are often highly complex, relying on multiple behaviours across multiple staff (often across multiple departments) [1]. Patients frequently slip through referral pathway cracks and as a result, may receive substandard clinical care [2]. When attempting

to improve referral pathways (or address other clinical problems), failure to capture the complexity of existing systems and processes may lead to the design of implementation interventions that target the wrong behaviour(s) for change, or lack relevance to local contexts [1].

Process mapping provides a visual representation of the processes that exist within systems into which new interventions are introduced [3]. By engaging multiple stakeholders and departments, process mapping provides opportunity to develop a shared understanding of the systems they are attempting to change [1]. It can also be a powerful tool in helping healthcare professionals visualize processes as they actually exist, and to be able to distinguish between work as imagined versus work as done [4]. A systematic review of the use of process mapping in the healthcare setting identified a number of reported benefits, such as enhancing understanding of local systems, informing the design of improvement interventions, and co-production and knowledge exchange among stakeholders [1]. Process mapping has been successfully used across a broad range of clinical settings, for example leading to improvements in: timing of prophylactic perioperative antibiotic administration [5]; teamwork in cardiac surgery [6]; inpatient suicide prevention programs [7] and primary care coordination [8].

In addition to the above benefits, process mapping can also help to facilitate identification of target behaviors for change. "Target behaviors" are behaviors that could bring about the desired improvement outcome [9]. Understanding the barriers to performing a specific target behavior allows selection of targeted intervention strategies to overcome them [10]. Process mapping provides an opportunity to define clinical practices in behavioral terms; specifying the actors, steps and decision points along the pathway. Identifying clinical practice gaps allows examination of the behaviors underlying those gaps, and identification of potential target behaviors for change [11]. Mapping proposed target behaviors to elements of the process map also enables the visualization of how an intervention will operate in the context of a larger system, and the potential consequences (positive or negative) its implementation may have on other parts of the system [10].

Evidence-based implementation frameworks have been developed to guide researchers and clinicians to develop an understanding of these processes, identify target behaviors for change and associated barriers, and design targeted intervention strategies [12]. However, inefficiencies have been encountered when attempting to apply these approaches in practice –often they require multiple stakeholder meetings and involve time-intensive analyses, which can be problematic in the context of busy and resource-limited clinical settings [13, 14]. Pragmatic approaches are needed to consolidate and streamline research activities where possible (e.g., establishing clinical processes, and identifying target behaviors for change and associated barriers, as part of the same consultation activity), whilst still achieving the key implementation objectives necessary for effective intervention design [14]; process mapping – whilst typically applied to generate a consensus based visual representation of the processes that exist within systems – can help to achieve this.

Lynch syndrome is an autosomal dominant hereditary cancer predisposition conferring an increased risk of colorectal, gynaecological, and other cancer types [15]. Tumor-based testing of LS associated cancers (through mismatch repair immunohistochemistry (MMR IHC) and/or microsatellite instability (MSI) testing) offers the ability to detect at-risk patients who warrant referral to specialist genetic services for germline genetic testing to establish a LS diagnosis [16]. Tumour microsatellite instability or loss of immunohistochemical expression of MMR proteins (without evidence of somatic inactivation as indicated by the presence of the *BRAF* V600E mutation or *MLH1* promoter hypermethylation) indicates high probability (24% – 67%) [17] of a pathogenic germline mutation in either of the four MMR genes – *MLH1*, *MSH2*, *MSH6*, and *PMS2* – causing LS [18]. Diagnosing LS can have long-term health benefits both for the proband and their at-risk relatives, with identified carriers having access to risk management strategies (such as colonoscopic surveillance, risk-reducing surgery, and aspirin prophylaxis) proven to reduce cancer incidence and mortality [19–22].

Despite these benefits, uptake of the LS tumor testing and referral pathway remains suboptimal [23–25]. An estimated 53% of Australian laboratories are yet to adopt a universal LS tumor testing strategy [26], and even when tumor testing is performed, referral rates to specialist genetic clinics [e.g., familial cancer clinic (FCC)] for germline testing for those with abnormal results (indicating a high risk of LS) are poor. Two recent Australian studies demonstrated that a minority (34% and 26%, respectively) of colorectal cancer patients with abnormal tumor test results were referred for genetic counselling and testing [24, 25]. Similar findings have also been demonstrated in the international setting [27–29], highlighting a need for implementation of interventions to improve genetic referral and LS diagnosis.

As a cluster randomized controlled trial (RCT), the Hide and Seek Project (HaSP) used a structured implementation approach to improving detection of LS across seven large Australian hospital networks [30]. A crucial first step in this process was to gain an in-depth understanding of the current clinical referral pathway at each site, identify variation and gaps in practice, and define key behaviors to be targeted in the design of tailored intervention strategies. The primary aim of the current study was to conduct an in-depth process mapping examination of the LS genetic referral pathway across a range of Australian hospital settings and to identify target behaviours for change (aim 1). Whilst we conducted a separate consultation activity to explicitly investigate barriers to identified target behaviors, we also sought to explore the extent to which barriers can be inductively captured and theoretically coded through process mapping focus-group data, as a way of consolidating implementation consultation activities [for providing potential pathways for intervention design] (aim 2). Furthermore, due to unexpected COVID-19 pandemic-induced restrictions on face-to-face contact which occurred in the middle of this project, we also report on the approach taken to quickly transition from an in-person to a virtual approach to process mapping LS referral (aim 3).

METHODS

Context – overview of the Hide and Seek Project

This study is part of a larger implementation trial aimed at improving LS tumor testing and referral practices in Australian hospitals. HaSP is a cluster RCT testing two structured implementation approaches, differentiated only by the explicit use of theory, for improving LS related molecular tumor testing and risk-appropriate referral practices for colorectal cancer (CRC) patients in seven large Australian hospital networks (clustered

by state). Post-intervention data analysis is currently underway. A detailed rationale, protocol and associated published works are available elsewhere [30–33].

Briefly, at each hospital network, a locally employed healthcare professional (e.g., nurse, genetic counsellor) was appointed and trained as an "Implementation Lead" to coordinate the implementation approach. Implementation Leads oversaw the following phases over a 2-year period: (i) baseline audits of LS referrals among CRC patients, (ii) formation of multidisciplinary "Implementation Teams," (iii) identification of target behaviors to achieve practice change, (iv) identification and confirmation of barriers to change, (v) generation of intervention strategies, (vi) support of staff to implement interventions, and (vii) evaluation of intervention effectiveness using audit and process evaluation data to assess practice and culture change. Clinical data was extracted to demonstrate pre- and post-implementation change, the primary outcome measure being the proportion of patients with risk-appropriate completion of the LS tumor testing and referral pathway. In March 2020, part way through the trial, a national lockdown was imposed due to the COVID-19 pandemic [34]. We had to quickly adapt our trial to ensure completion of each phase of the trial underway at each site, which included adapting process mapping methods from an in-person to virtual approach, delivered by our trained Implementation Leads. A COVID-19 protocol supplement (included in Additional File 1) authorized the use of virtual methods, and the research team developed site-specific plans in conjunction with affected Implementation Leads.

Process mapping and target behaviors focus groups

Implementation leads received prior training in process mapping [31] and were instructed to facilitate two Implementation Team focus-groups over the course of 4–8 weeks: the first focus-group to discuss a site-specific "process map" of the LS referral pathway, and the second to use the process map and baseline audit data (presented in an "outcomes map") to confirm potential target behaviors for change (see Fig. 1). Training included an overview and rationale of process mapping, discussion of focus-group facilitation skills, and a simulated example group process mapping exercise. The research team held teleconferences with the Implementation Leads before each focus-group, to walk through the process and resources provided. Additional File 1 contains instructions and key resources provided to the Implementation Leads.

Participants and recruitment

Implementation Leads used snowball methods to recruit a multidisciplinary team of stakeholders involved in the LS referral pathway. Potential participants were identified in consultation with site Principal Investigators, based on their existing knowledge of internal LS stakeholder networks. Implementation Leads were instructed to seek representation from key departments known to be involved in the LS referral pathway, including: pathology, surgery, oncology, nursing, and genetics. Potential participants were invited to participate in the focus groups via email, with a request to forward the invitation to other eligible stakeholders. Although efforts were made to coordinate single multidisciplinary focus groups at each site, multiple focus groups or individual interviews took place at some sites due to
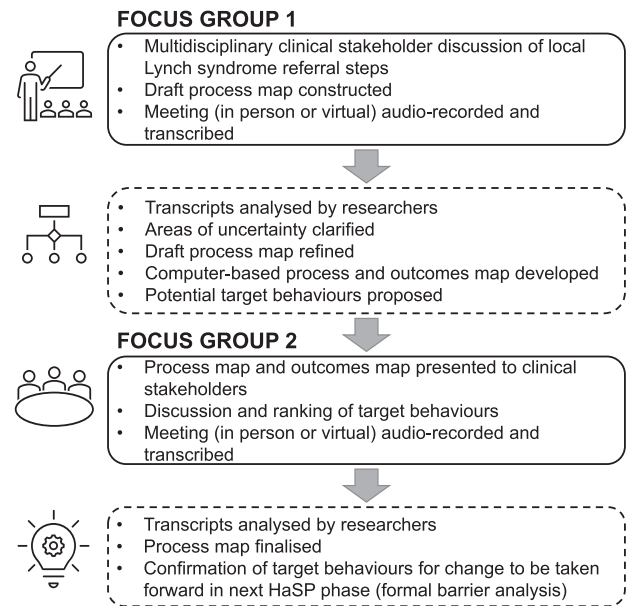
Fig 1 | Key steps involved in process map development and target behavior identification.

scheduling conflicts. Participants were informed that focus groups would be audio-recorded and transcribed for analysis, and written consent was obtained prior. In some sites one or more focus groups were conducted using a videoconferencing platform.

Focus-Group 1 (process mapping)

A structured focus-group agenda was provided to the Implementation Leads prior (see Additional File 1), together with resources and tools to support process map development (e.g., pre-labelled cards of known process steps, decision points, and terminator points, sticky notes to allow focus-groups to add additional steps/points to pre-labelled cards, an example process map). During Focus-Group 1, stakeholders discussed what they believe current LS tumor testing and referral processes were at their site. This involved in-depth discussion of the step-by-step practices and decisions that are made from the point of CRC biopsy/resection, through to receipt of referral by the FCC. During this time, the Implementation Lead sketched out an initial draft referral process map. Following the focus-group, the draft process map and an audio-recording of the meeting was sent to the research team for analysis. In a study site that held virtual focus-groups, physical resources were substituted by using an online collaborative whiteboard platform. A member of the research team supported the Implementation Lead to arrange and create process steps in the online whiteboard throughout the focus-group. A screen shot of the online whiteboard process map was sent to the research team.

Between Focus-Group 1 and Focus-Group 2

Focus-group transcripts were analyzed by the research team to further develop and refine the draft process map (see "analysis" section) and generate a computer-based map using MS PowerPoint. Areas of uncertainty (e.g., steps in the process that were missed or not clearly described in the Focus-Group)

were flagged – for the Implementation Lead to clarify with stakeholders – prior to Focus-Group 2.

Two maps were provided as complementary resources in Focus-Group 2: a site-specific process map (providing detailed pathways of all the behaviors, steps and decision points in the LS referral pathway); and an "outcomes map" delineating, in a simplified form, the number of patients transitioning through key clinical steps along the pathway. The outcomes maps were developed by a member of the research team with genetics and statistical expertise (JS) based on HaSP clinical audit data, reported in detail elsewhere [33].

During the development of the process and outcomes maps, potential "target behaviors" for change were identified. These were based on the testing and referrals gaps and bottlenecks identified from the clinical data, as well as corresponding qualitative descriptions (resulting in missed genetic referral opportunities) identified in focus-groups and from the process map. The research team met to discuss and refine the process map, outcomes map, and potential target behaviors. Implementation Leads also reviewed the process map prior to Focus-Group 2. The same process was followed at all sites, regardless of an in-person or online approach.

Focus-Group 2 (target behaviors)
During Focus-Group 2, stakeholders were presented with a site-specific process map, outcomes map, proposed target behaviors, and a target behavior rating criteria form. In a site that held the focus-group by videoconference, ranking was performed using an online poll. A summary diagram was also provided to demonstrate how the different sources of evidence were used to identify each target behavior. Attendees were asked to review the process map and outcomes map (with opportunity to make further refinements to the process map), and rate proposed behavioral target areas for change, with the opportunity to identify additional target behaviors. An audio-recording of the meeting was again sent to the research team for analysis to confirm the target behaviors for change.

Analysis
An inductive content analysis approach was used to identify site-specific process steps in the LS referral pathway (aim 1). Content analysis is a research method that can be used to make inferences from data to their context to gain a condensed and broad description of the phenomenon being studied [35, 36]. Hierarchies of concepts and categories are identified from the data and can be organized into conceptual models and systems – in this case, "process maps" [36]. Deidentified transcripts were analyzed line-by-line by two members of the research team (AM, with either GT, PC, or EK) to identify concepts and categories, which were visually represented as a site-specific "process map". Process maps were reviewed and discussed among the broader research team and site Implementation Leads to ensure accurate representation of the data.

Qualitative analysis of the process mapping focus-group transcripts also served to explore the extent to which referral barriers could be inductively captured and theoretically coded through process mapping focus-group data (aim 2). Audio transcripts were de-identified and coded via the qualitative analysis software NVivo Version 12 (QSR International, Victoria, Australia). An overarching coding tree was informed

by the process map content analysis, with identified barriers organized according to areas of variation and gaps in clinical practice. An inductive thematic analysis approach was used, with barriers initially identified then categorized according to domains of the Theoretical Domains Framework (TDF [37];). The TDF is a validated framework that can be used to classify barriers according to theoretically underpinned psychosocial domains of behavior change, and has been extensively used across a range of clinical settings [38]. This analysis was completed by two members of the research team with experience in using the TDF (AM, NT).

RESULTS

Demographics
Across all seven sites, there were 86 attendees (excluding the Implementation Lead facilitators) together for both Focus-Group 1 and Focus-Group 2. On average, there were six LS stakeholders per focus-group. The most frequent clinical specialty participant group were colorectal surgeons (N = 29), followed by genetics staff (including geneticists and genetic counsellors; N = 16) and pathologists (N = 16). Table 1 provides a summary of the participant breakdown for focus-groups held at each site. Response rate could not be calculated due to the snowball methods used.

Process maps (aim 1)
Summary process map
For illustrative purposes, a simplified summary process map was developed (see Fig. 2) based on the key stages of the LS pathway that were common across all seven site-specific process maps. Across all process maps, standard symbols were used to represent each step: start and end points (rounded rectangles), decision points (diamonds), process steps involving activities (rectangles) with arrows indicating the directional relationships between different steps in the LS referral pathway [39]. Solid diamonds represent termination points at which no genetic referral is made.

Site process and outcomes maps generated in person and virtually
The full process mapping exercise across all sites is provided in Additional File 2, with similar levels of process map detail captured through both in-person and virtual methods. One example site process map of the LS referral pathway for colorectal cancer patients is provided in Fig. 3. A narrative description of the process was provided for each site to accompany the maps, with corresponding steps in the pathway labelled for reference (e.g., A1, A2, B1, B2 etc). Symbols have been colour-coded according to the key referral pathway elements shown in Fig. 1.

An example outcomes map (representing LS clinical audit data), is provided in Additional File 3. The analysis of patient data underlying the outcomes maps is reported in detail elsewhere [33]. Fig. 4 demonstrates how process and outcomes maps were used together as a resource in Focus-Group 2 to highlight the behaviors associated with suboptimal referral practices, and identify target behaviors for change.

Practice variation and associated barriers (aim 2)
Comparison of site process and outcomes maps highlighted six key areas of variation and gaps in clinical practice: the

Table 1 | Focus group participants by clinical specialty

Site	H1		H2		H3		H4		H5		H6		H7	
Focus group #	FG1	FG2	FG1	FG2	FG1	FG2	FG1	FG2	FG1	FG2	FG1	FG2	FG1	FG2
Discipline														
Colorectal surgery	1	1	0	2	2	1	2	4	6	3	4	2	1	0
Pathology	1	2	0	0	1	2	2	1	1	1	2	1	1	1
Genetics	1	0	2	3	1	2	1	1	0	1	1	1	1	1
Medical Oncology	1	1	0	1	2	0	1	0	0	0	1	1	1	1
Nursing	1	1	0	2	0	0	1	0	0	1	1	0	1	0
Radiation Oncology	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Medical Imaging	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Hospital administration	0	0	1	1	0	0	0	0	0	0	1	1	0	0
Total	5	5	3	9	6	5	7	6	7	6	12	6	5	4
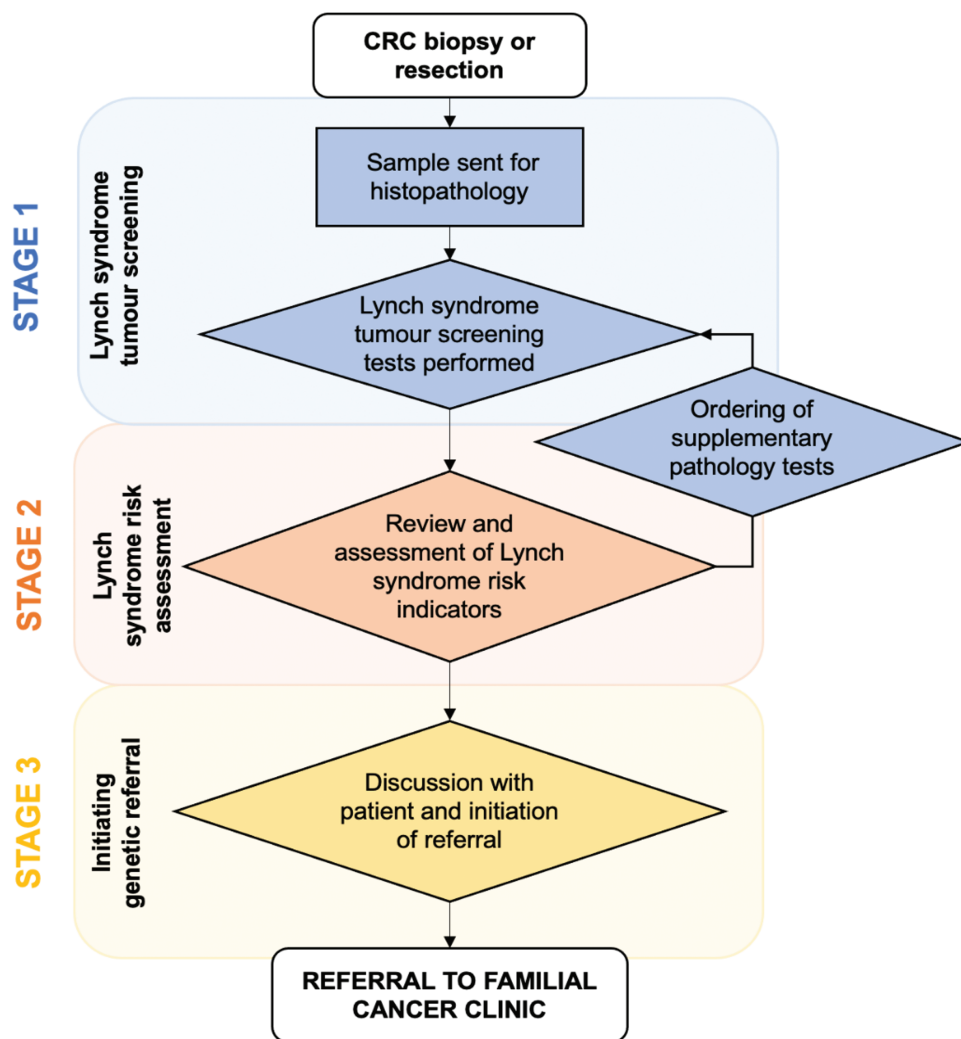
Fig 2 | Summary of key process map stages.

sample upon which to perform LS tumour tests, ordering of supplementary pathology tests (e.g., *BRAF* V600E and/or *MLH1* methylation tests), performance of MMR IHC, obtaining multidisciplinary input to assess LS risk, applying LS referral guidelines, and timing of discussion about genetic referral. These are summarized in Table 2, together with the corresponding TDF-mapped barriers identified through the qualitative analysis. Clinical practice variations are also visually represented in the site-specific process maps available in Additional File 2. Ten barriers were identified, which were mapped to seven TDF domains. The most frequently identified domains were: *environmental context and*
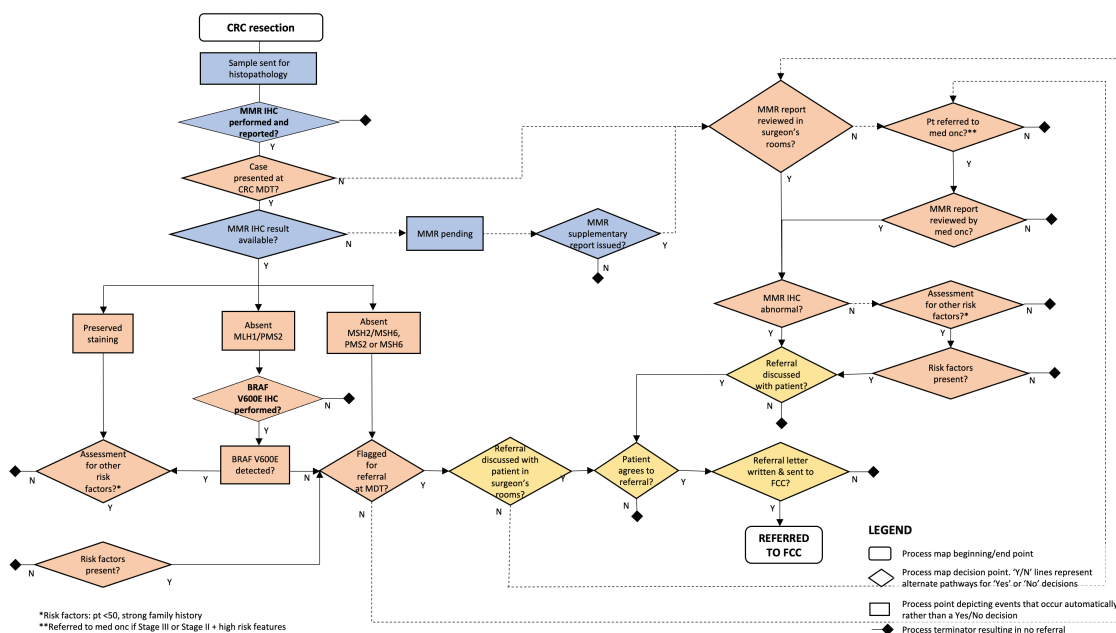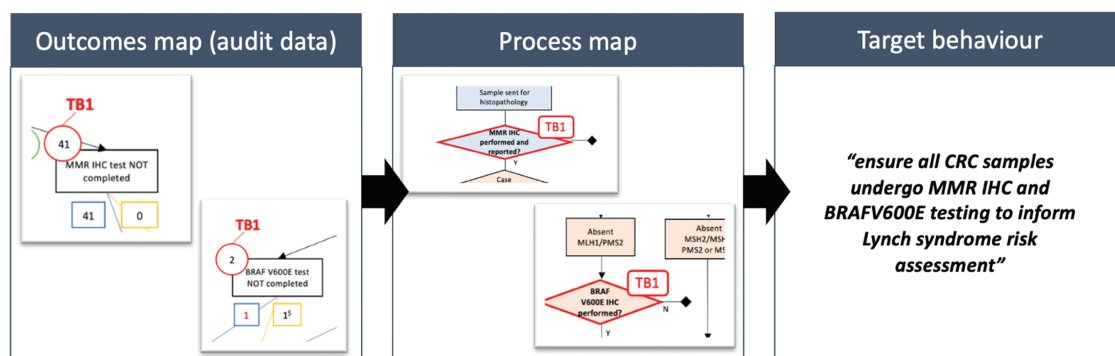
Fig 3 | Example site process map.

Fig 4 | Relationship between process map, outcomes map and target behaviors.

resources; *memory, attention and decision processes*; and *knowledge*.

Discussion

In the context of the HaSP trial, process maps provided a visual representation of the behavioral processes involved in LS referral. Whilst process mapping has been used extensively in quality improvement work [40], it is not a common practice within implementation research [3]. We have demonstrated a novel example by which traditional process mapping methods have been extended in three ways: i) process maps can be interpreted alongside clinical audit data to demonstrate the *behaviors* associated with suboptimal clinical outcomes, ii) incorporating qualitative analysis can further enable the identification of barriers to target behaviors which, when mapped to a theoretical framework (in this case, the TDF), can provide opportunities for the design of targeted, evidence-based implementation strategies, and iii) process mapping focus groups can be successfully undertaken virtually to generate maps that can be used alongside audit data to identify target behaviors for change.

Process maps were useful in highlighting current system complexity, existing gaps and bottlenecks, and clinical practice variation in the LS referral pathway. Most notably, comparison of process maps across the seven sites highlighted significant variation in LS pathology practices. For example, some institutions applied age-related tumor testing cut-offs, whilst others adopted a universal approach; some conducted tumor screening tests preferentially on the biopsy sample, whilst others preferentially tested the tumor resection sample; and some conducted reflex supplementary tests, whilst others only performed supplementary tests upon clinician request. This is in line with findings from a recent survey of Australian pathology providers, whereby protocols for LS tumor screening among newly diagnosed colorectal cases varied widely: 47% of participating laboratories reported following a universal approach (e.g., without applying an age limit), 30% tested only "red flag" cases (e.g., young age at onset, strong family history) and 6% performed tests on clinician request only [26]. The variability observed in the survey (and in the process maps presented in this chapter) reflects the lack of national policy in Australia to guide LS tumor screening tests. Efforts are currently underway through The Inherited Cancer

Table 2 | Summary of clinical practice variation between sites and inductively captured barriers to performing target behaviors

Target behavior areas	Variation in between sites in process steps	Barriers identified (*TDF domain*)	Supporting quotes
1. Lynch syndrome tumor screening	**Sample upon which to perform Lynch syndrome tumor tests**: MMR preferentially performed on the CRC biopsy sample at some services (e.g. H1, H6), versus the resection sample at others (e.g. H2, H3, H4, H5).	Lack of institutional guidelines and/or systems to determine the appropriate sample for testing (*Environmental context & resources; Memory, attention & decision processes*).	"*It may get lost… Sometimes with rectal cancers or any cancer that's had neoadjuvant therapy, it may not get done from assuming that it had been performed beforehand.*" Pathologist, H5
	Ordering of supplementary BRAF V600E and/or methylation testing: various approaches were identified for performing supplementary tests. At some sites, *BRAF* V600E and/or *MLH1* methylation testing was initiated reflexively following loss of MLH1 & PMS2 (e.g. H3, H4, H6), whilst others were dependent on clinician request (H2, H5). Two sites (H1, H7) performed *BRAF* V600E concurrently alongside MMR IHC (regardless of MLH1 and PMS2 staining).	Mixed perceptions among individual clinicians about the clinical utility of supplementary tests for Lynch syndrome (*Optimism*). Clinicians (particularly juniors) may not be aware of the need to order supplementary BRAF V600E tests (*Knowledge; Skills*).	"*It's not in my algorithm at all. If the genetics guys wanna do it to get a rough idea, it's a costly test for something that's not definitive.*" Colorectal surgeon, H5 "*It's something not everybody would pick up. Probably most people would, but there'd be some that wouldn't and there'd be some trainees that might not until they're taught to do it.. That knowledge is gradually improving but it's that evidence practice gap that takes time and practice to increase education and awareness.*" Medical oncologist, H5
	Completion of MMR IHC: outcomes maps demonstrated wide variability across sites for undertaking MMR IHC. One site achieved 100% (H7), whilst at other sites, up to 18% of CRC patients had incomplete tumor testing.	High workload pressures meant that pathologists were more likely to forget to perform the appropriate tests (*Memory, attention & decision processes; Environmental context and resources*).	"*It's not that uncommon that I – and maybe it's a pressure at work and getting the biopsy report off your desk, and I forget to order the MMR.*" Pathologist, H1
2. Lynch syndrome risk assessment	**Obtaining multidisciplinary input to assess Lynch syndrome risk**: most sites had mechanisms in place through multidisciplinary team (MDT) meetings to assess Lynch syndrome risk. Some hospitals (e.g., H2) had additional processes in place to ensure MDT referral recommendations were captured and actioned upon by the treating clinician. However, one site had no such MDT processes in place (H5).	Time and other clinical priorities can prevent discussion of Lynch syndrome risk at the MDT meetings (*Environmental context and resources*). Clinicians rely on input from genetic staff at the MDT, and may not feel confident making decisions about Lynch syndrome referral independently (*Skills; Knowledge*).	"*We try to discuss the MMR and the BRAF status at the meetings. It doesn't happen in all cases because sometimes time is the barrier.*" Colorectal surgeon, H6 "*I don't think there would be a lot of confidence to make a referral independently without [genetics] input. You often do flag it – I mean there's a couple of particular doctors who pay a lot of attention to it, but I think there's a lot that don't.*" Genetic counsellor, H2
	Applying Lynch syndrome referral guidelines: there was variation between sites in the criteria used to determine appropriateness for genetic referral. For example, some sites applied age-at-diagnosis thresholds prompting referral regardless of tumor risk indicators (CRC diagnosis under 40 years of age was considered appropriate for referral at some sites, as opposed to under 50 at others, whilst some did not appear to apply specific age criteria at all). Gaps in practice were also identified in relation to the use of tumour test results to guide referral decisions, with outcomes maps demonstrating potentially inappropriate referral of patients with absent MLH1 and PMS2 staining, but presence of the somatic *BRAF* V600E mutation (indicating low risk of Lynch syndrome).	Difficulty interpreting molecular tumor screening results to assess a patient's risk of Lynch syndrome and make an appropriate referral (*Memory, attention & decision processes*). Difficulty remembering genetic referral criteria (*Memory, attention & decision processes; Knowledge*).	"*Just be aware of the confusing terminology. So 'present' means this and 'absent' means this and the pathologists can use an amazing array of terminology. It's like it's written in ancient Greek.*" Genetic Counsellor, H2 "*I don't know it anymore [genetic referral criteria]. I did it for the exam, the day after I forgot… Now I've got to go back and look at a whole lot of patients.*" Colorectal surgeon, H6

Table 2. Continued

Target behavior areas	Variation in between sites in process steps	Barriers identified (*TDF domain*)	Supporting quotes
3. Initiating genetic referral	Timing of discussion about genetic referral: whilst all sites recognized the role for surgeon-initiated referral at the time of CRC diagnoses (or soon thereafter), some sites had additional mechanisms in place for medical oncologists to initiate a discussion about referral later in the treatment trajectory, if previously missed.	Treatment priorities can get in the way of surgeons/oncologists discussing or initiating a genetic referral (*Environmental context & resources; motivation & goals*). The patient may also be emotionally overwhelmed at the time of diagnosis and defer/decline genetic referral (*Emotion*).	"*If they're having chemotherapy, either the clinician or patient may say, 'Let's delay the referral because I'm having or you're having chemotherapy for six months. I wanna focus on the treatment now and deal with that later,' That behaviour, I think, is quite a dangerous one, isn't it? Because we might forget at the end.*" Colorectal surgeon, H6
		Lack of defined roles and responsibilities among different clinical disciplines involved in the CRC treatment and Lynch syndrome referral pathway (*Social/professional role & identity*)	"*It seems like this referral process is deemed very important, but not important enough that these people fall through the cracks that someone is responsible. And I guess the other thing is, who is responsible?*" Colorectal surgeon, H5

Connect (ICCon) Partnership (https://www.petermac.org/research/clinical-research/clinical-research/familial-cancer-research-centre/iccon-database) to develop such a policy. However, in the interim, this work provides an opportunity for hospital staff to review their practices and ensure that staff are aware of local protocol processes. Across the course of the study, some participating sites noted that changes to their LS pathology practices were underway.

As demonstrated in this study, incorporating qualitative analysis methods can further enhance the value of process maps as an implementation tool. Qualitative analysis of focus group transcripts provided valuable insights about the behavioral determinants associated with gaps in clinical practice. Although barrier exploration was not the primary aim of the process mapping focus groups (they were formally assessed in a later phase), structured discussion of the LS referral pathway naturally prompted discussion of barriers relevant to the local context. Classifying these barriers according to a theoretical framework can provide a pathway for targeted, evidence-based intervention design to resolve the clinical practice gaps identified through the process and outcomes maps. Formally incorporating barrier identification as a secondary process mapping outcome (thereby consolidating these two distinct, yet complementary, implementation objectives) may provide a pragmatic solution for resolving inefficiencies in implementation strategy design and enabling a more streamlined approach for future implementation efforts. Further research is needed to develop and test these approaches, to demonstrate their feasibility across other clinical settings, and to determine whether there are additional ways to streamline without compromising quality.

A key strength of this study is the extent to which process mapping methods have been reported. Whilst some minor challenges were reported at the site utilizing the less traditional virtual process mapping method (including more upfront preparation and training required, as well as an additional support person during Focus Group 1), this approach retained the robust principles of process mapping and was shown to be a feasible alternative. We have provided a detailed description of the process mapping methods used, from the point of preparation and planning, data and information-gathering, and map generation, through to process analysis and next steps forward, thereby aligning with the conceptual framework criteria proposed by Antonacci, Lennox [1]. Furthermore, additional materials provide a complete representation of the process maps that were developed through the exercise, and the ways in which maps were annotated with clinical audit data to highlight process gaps. Providing this detail is crucial for harnessing the full potential of process mapping as an implementation tool, and advancing the field of implementation science more broadly [1].

This study is not without limitations. Different Implementation Leads facilitated the focus groups at each site. Whilst all received the same process mapping training and structured focus group guides, it is possible that the depth of information gained from the exercise (and therefore the quality of the process maps) was somewhat determined by the skillset of the facilitator. Furthermore, some sites were unable to achieve multidisciplinary representation across all key clinical specialties involved in the LS referral pathway. In such instances, process map steps may be missing or inaccurately represented. Furthermore, patient stakeholders were not included in the focus groups, therefore additional patient-related clinical pathway barriers may exist beyond those captured in this study from the clinical stakeholder perspective. Nonetheless, this study has provided valuable insights about gaps and variations in clinical practices surrounding LS referral, both within and between Australian hospital networks. Gaining an in-depth understanding of the steps and behaviors underlying these clinical practice variations is key to informing implementation efforts overcome them.

CONCLUSION

Process mapping, undertaken both in-person and virtually, has been an invaluable HaSP implementation tool, highlighting a number of gaps and variations in clinical practices surrounding genetic referral for LS. The exercise also facilitated qualitative exploration of theoretical barriers to optimal LS detection, which can inform the development of targeted, evidence-based implementation strategies.

List of Additional Files

Additional File 1 – (docx., Title: Step 3 of Hide and Seek Project: identifying target behaviours for change via process mapping, Description: instructions and resources provided to Implementation Leads to guide them through conducting focus groups 1 and 2)

Additional File 2 – (pptx., Title: Site-Specific Process Maps, Description: maps of LS referral processes in seven Australian hospital networks)

Additional File 3 –(docx., Title: Example site outcomes map, Description: an example of one of the site-specific outcome maps).

Compliance with Ethical Standards

Conflicts of Interest:

The Authors declare no competing conflicts of interest.

Human Rights:

All procedures performed in studies involving human participants were in accordance with Royal Prince Alfred Hospital Human Research Ethics Committee (reference HREC/17/RPAH/542) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent:

Informed, written consent was obtained from all focus group attendees.

Welfare of Animals:

This article does not contain any studies with animals performed by any of the authors.

Transparency Statements:

Study registration: This study was not formally registered. Analytic plan registration: The analysis plan was not formally pre-registered. Availability of data: Please contact the corresponding author for more information. Availability of analytic code: Please contact the corresponding author for more information. Availability of materials: Materials used to conduct this study have been provided as additional files with this submission.>

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