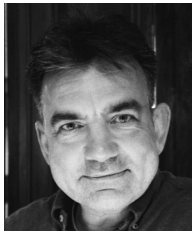


# Patient Ecosystem Mapping (PEM): Supporting System-Shifting in Healthcare

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Many approaches to innovation are active in the health sector, the majority derived from the world of quality improvement. While these methods are potent and can yield significant results, when used in healthcare they frequently concentrate on individual patient pathways or specific components of a healthcare system - yet many of the challenges in healthcare are associated with patient and staff experiences and the poor interfaces between different parts of a service. In the conventional quality improvement (QI) toolbox there are relatively few methods that support exploration of these more holistic challenges. Design and systems thinking, however, have much to offer. Design thinking has methods and frameworks that put the user at the centre, encourage divergent and convergent thinking, promote early prototyping & iteration and support collaboration through visualisation. Systems thinking helps map the complex connections and relationships between different actors and elements within a system, it explores flows & feedback loops and encourages looking at the system in its entirety from the perspectives of events, trends, connections and mindsets. To translate design and systems thinking into action, healthcare professionals need design and systems methods that are framed around their very particular challenges, are described in the vocabulary of health and complement existing paradigms of quality improvement. This paper describes how a Patient Ecosystem Mapping methodology has been developed that enables a healthcare team to build a 'London Underground' style map of the patient pathways within which they work and then use this to reflect on potential improvements. The principles of the mapping process are described. Examples of how the Patient Ecosystem Mapping methodology has been used on various projects and Scotland and Northern Ireland are described. The maps have acted as Boundary Objects, breaking down silos and empowering teams to take ownership of their areas of healthcare. The way different frameworks from systems thinking, such as the iceberg model, have been used to help review the maps is also described. The work is a case study in how design and systems thinking principles can be integrated into a working

method with real world value. The work is also a case study in how non-design professionals (from healthcare) can be upskilled in design approaches.

*Key words:* boundary objects, design methods, ecosystems, healthcare, iceberg models, mapping, quality improvement, systems, system-shifting, visualisation

## Introduction

Health services everywhere are working under intense pressure; never has the need for innovation been higher. The majority of innovation in healthcare is based on Quality Improvement (QI) methods developed in other sectors like manufacturing. In the US, organisations like the Institute for Healthcare Improvement (IHI) have been major proponents of this approach since the late 1980s, the QI is now widely practised in health and care systems across the world (Perla, 2013). Examples of widely used QI tools are listed below:

- **Pareto Analysis:** Helps focus on the factors that have most impact
- **Process Mapping:** Maps performance of a process
- **Cause & Effect Diagram:** Helps identify the causes of the problems you are facing
- **Plan-Do-Study-Act (PDSA):** An approach to testing ideas
- **Measurement Plans:** A way of setting out details for each measure in an improvement project
- **Model for Improvement:** A model for accelerating

improvements that are already being planned

Over the last 20 years many initiatives have sought to augment conventional QI tools by bringing a design perspective into the improvement mix. (Oliveira et al, 2020) describe how design thinking provides a framework for balancing contextual factors in healthcare improvement (eg users, stakeholders, resources and clinical evidence). (Inns & Mountain, 2020) describe how design thinking can help put the patient at the centre of improvement projects, encourage healthcare professionals to take a step back and support creativity, structure and collaboration.

QI methods and other tools from domains like design can deliver significant impact, but often they focus on 'drilling down' into a healthcare system, optimising individual pathways or specific elements within a service. Yet many of the emerging challenges in health & care require us to see the bigger picture, to shift the emphasis to prevention, improve the interfaces between patients & service-users and professionals and be more mindful of

the population's rapidly changing needs.

Within healthcare research there is a growing interest in systems approaches to QI which explore the bigger picture. (Komashie et al., 2021) have reviewed the evidence base for a systems approach to healthcare QI and concluded that the right approaches can result in a statistically significant improvement to both patient and service outcomes. The report 'Engineering Better Care' (Royal Academy of Engineering, 2017) describes how:

All improvement initiatives involve people, processes, technologies and systems that, in turn are part of other systems. This complexity means that all parts of the health and care system stand to benefit from using an approach which considers each relevant element of the overall system and joins them up effectively.

In the conventional QI toolbox there are, however, relatively few methods that support 'zooming out' to explore these more holistic challenges.

This paper describes the contribution that a Patient Ecosystem Mapping (PEM) methodology makes

to this challenge. The paper begins with an overview of the evolution of this method over the last four years. An overview is given of how this approach has borrowed from mapping approaches used to describe transport systems. The PEM methodology and its application are then described as a step-by-step process which can allow a healthcare team to take a systems approach to improvement. Finally, three mini case studies are provided outlining how the approach has been used to support real-world healthcare improvements and how this has added value to the teams delivering these projects.

### ***The evolution of the Patient Ecosystem Mapping (PEM) methodology***

The Patient Ecosystem Mapping methodology has evolved through a series of projects undertaken by the author in very close collaboration with many health and care professionals over the last four years.

In these initial mapping projects, the author worked with teams of healthcare professionals as an embedded researcher and a designer. This practice-based design research approach used principles described in Vaughan, 2017. The research dimension of this role was informed by a clear set of research questions, described below:

1. How can we create a high-level overview of a system of health & care?
2. How can we deduce a set of rules and principles to allow the

approach to be repeatable in different health and care contexts?

3. What value does the process and existence of high-level maps play in the quality improvement work of healthcare teams?

The design dimension involved the author creating things (visual representations). These had to be conceived in a way that would allow them to be used as 'tools' to support a process of decision-making. Effectively the author was working as a 'tool designer'. Ullmann, 1997, provides a useful generic overview of how a tool adds value to innovation decision-making processes. This set of principles, described below, was used as a brief to inform the design element of the PEM practice-based research:

- **PEM had to be learnable:** To be an effective tool, PEM had to be capable of being broken down into a set of guidelines to enable others to take on board the approach and embed it within their own projects. To work as a tool, it was important that PEM described a check list of generic issues that should be considered when applying the methodology.
- **PEM had to structure complex information logically** Tools work by unpacking what can be complex information, often held in the minds of different stakeholders, into smaller chunks for analysis. The PEM methodology had to be capable of unpacking a complex system

through co-creation and then presenting it back in a logical visual way to allow teams to hold an overview of the system in their minds, whilst also enabling zooming in to allow team discussion about individual elements within the system.

- **PEM had to be understandable** To get buy-in and traction it is essential that tools are easy to understand and use the vocabulary of their user group. For PEM this really understanding the terminology of health and care professionals.
- **PEM had to work as an aid to decision-making** When designing the PEM approach, it was really important to understand that the PEM was not the end point, the purpose of the PEM representation was to support subsequent quality improvement decision-making.

This sequence of projects which informed the development of the PEM approach are shown in Figure 1. The contribution of each of these activities to the development of PEM is described overleaf.

In 2019 the quality improvement team at NHS Tayside (one of Scotland's 14 Regional Health Boards) commissioned the author to help develop an integrated curriculum of conventional quality improvements methods, augmented with appropriately customised design methods for its Tayside Quality Improvement Programme. The development and impact of this

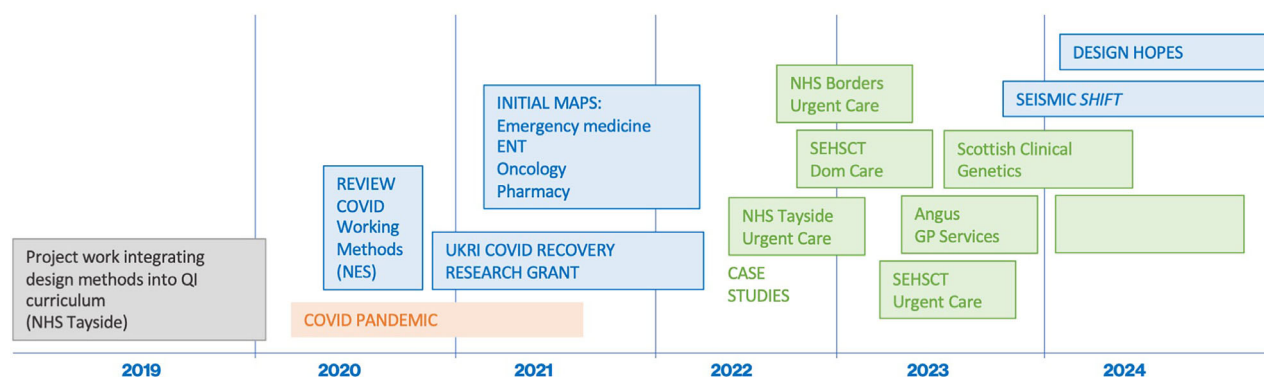


Figure 1. Timeline of PEM development projects. [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1111/dm.12098)]

training is described in (Inns & Mountain, 2020). This project work equipped the author with an understanding of how to translate design tools into a health & care vocabulary and how they would bring leverage in quality improvement projects.

In March 2020 everything changed. With a rapidly emerging understanding of the impact that the Covid pandemic would have, NHS Tayside, like regional health boards and trusts across the UK became focused on dealing with the disruption of this global pandemic.

The NHS Tayside Improvement Academy building was turned into a COVID Command Centre. Quality Improvement training and projects were put on hold and staff across the healthcare system found themselves working in new ways. Over the following weeks Tayside's COVID experience mirrored that experienced by healthcare boards and trusts elsewhere with cancellation of elective care, the challenges of an unknown

virus, new ways of working and harrowing patient, family and staff experiences.

Two months into the pandemic, however, it was clear that something else had changed in NHS Tayside. Ideas that had been on the drawing board for months if not years were developed in days and deployed in weeks. Staff suddenly founding themselves working across unfamiliar areas of healthcare discovering new colleagues, meetings moved from choreographed, calendared encounters to agile online conversations, resources were suddenly unlocked.

In June 2020, working with NHS Education for Scotland (NES), the author was commissioned to run a series of Discovery Workshops with clinicians, nurses and managers from across Tayside's Primary and Secondary system to reflect on what these new ways of working were and establish what lessons could be learnt for the future. Findings were striking, silos and disciplinary boundaries had dissolved, a system with a shared

purpose had emerged, communication had improved, rapid prototyping & testing of many ideas was being undertaken, all conditions synonymous with a culture of innovation. These findings directly informed the three research questions described above that informed the PEM development.

To try and capture some of this new approach to healthcare improvement, for when the healthcare system inevitably reverted to Business-as-Usual, UKRI COVID Recovery Project Funding was secured by the author and a team NHS Tayside & NES to develop a co-design tool that would answer these research questions and develop a new systems approach to healthcare quality improvement.

With this support, between Nov 2020 and April 2022, this group set about developing the Patient Ecosystem Mapping (PEM) Tool. The aim was to allow a healthcare team to collectively map their ecosystem of healthcare, from a patient perspective to allow

collaborative reflection on challenges and system wide opportunities for improvement.

The approach was developed in an iterative way through short-life projects with different healthcare teams in NHS Tayside. During this process of discovery very early iterations of Patient Ecosystem Maps were developed with health and care professionals in Primary Care, Emergency Care, ENT services, Nursing in Care Homes, Pharmacy Services and Oncology Services. The approach was also deployed to map out viral and non-viral pathways through Ninewells Hospital, Dundee in early 2021 as the health care system began to move out of COVID restrictions. To inform the design elements of the project a range of journey mapping methodologies derived from service design (Stickdorn & Schneider, 2010) were experimented with. These methods were deployed through both online and face-to-face workshops. The visual representations created through these initial projects added value to the teams helping them see the connections between different parts of their services and identify challenges. (see Figure 2) It was clear, however, that much of this mapping was dependent on the tacit skills and interpretation of the author and that there were multiple ways of mapping and reflecting on the same information. A great historical exploration of this challenge is provided by Turchi, 2004.

Within the design field this is an area of significant discussion. Two

areas of this debate that seemed very relevant to the PEM project work were:

- Firstly, the challenges of visualising information as discussed by authors like Newman, 2017, and in particular building representations of complexity in design, Sevaldson, 2011.
- Secondly, the way that a systems-based design approach can help influence change as discussed by authors such as, Biji-Brouwer & Malcolm, 2020.

In discussion with health and care professionals it was clear that if an approach was to be developed that could ultimately be actioned by others with minimal training the approach had to be easy to explain, understand and execute.

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A wide variety of approaches to mapping, which were clearly repeatable were explored through discussion at the early mapping workshops, most participants could relate to systems of mapping that they had experienced in their own personal and professional lives. Visual mapping approaches that health and care professionals were clearly very familiar with included the way transport maps have been created over many years to navigate a particular geography. Two approaches to achieving this were discussed, the London Underground

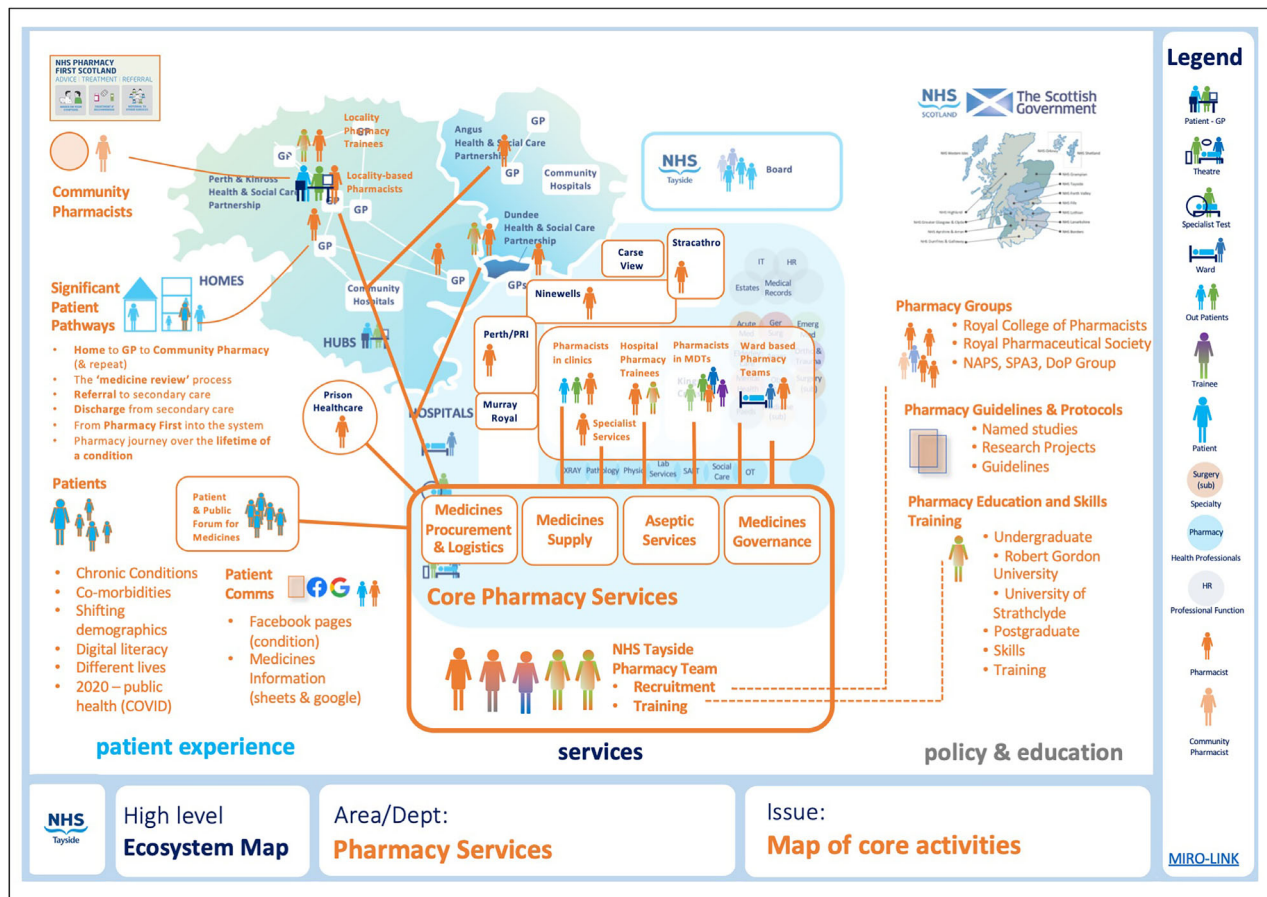


Figure 2. Visual representation of Pharmacy Services at NHS Tayside created in early project work. [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

Map and the way Google maps describe information.

The ‘London Underground’ map was originally created in 1933 by Harry Beck. The many phases in the development of this are described in Garland, 1994. In the PEM planning workshops the principles of this were deconstructed to inform how a Patient Ecosystem Mapping approach could be codified, from this 5 relevant principles were deduced:

1. The London Underground Map (Figure 3) is an abstraction of

reality, it doesn’t show the actual geographic location of stations and lines, just their relative location a high-level overview of the facilities at stations and how travellers can navigate the system. In the PEM approach the focus is the way patients navigate a system of healthcare, places where healthcare is accessed are the equivalent of stations, onto which a high-level overview of the people a patient might interact with can be marked up,

these are connected by pathways of care, the relative position of these is shown but not the exact location.

2. The London Underground map shows independent lines that then interconnect (Victoria Line, Circle Line etc) with traveller journeys being determined by individual needs. In the PEM approach the map is made up of different healthcare pathways that connect with each other (cardiac, respiratory etc)

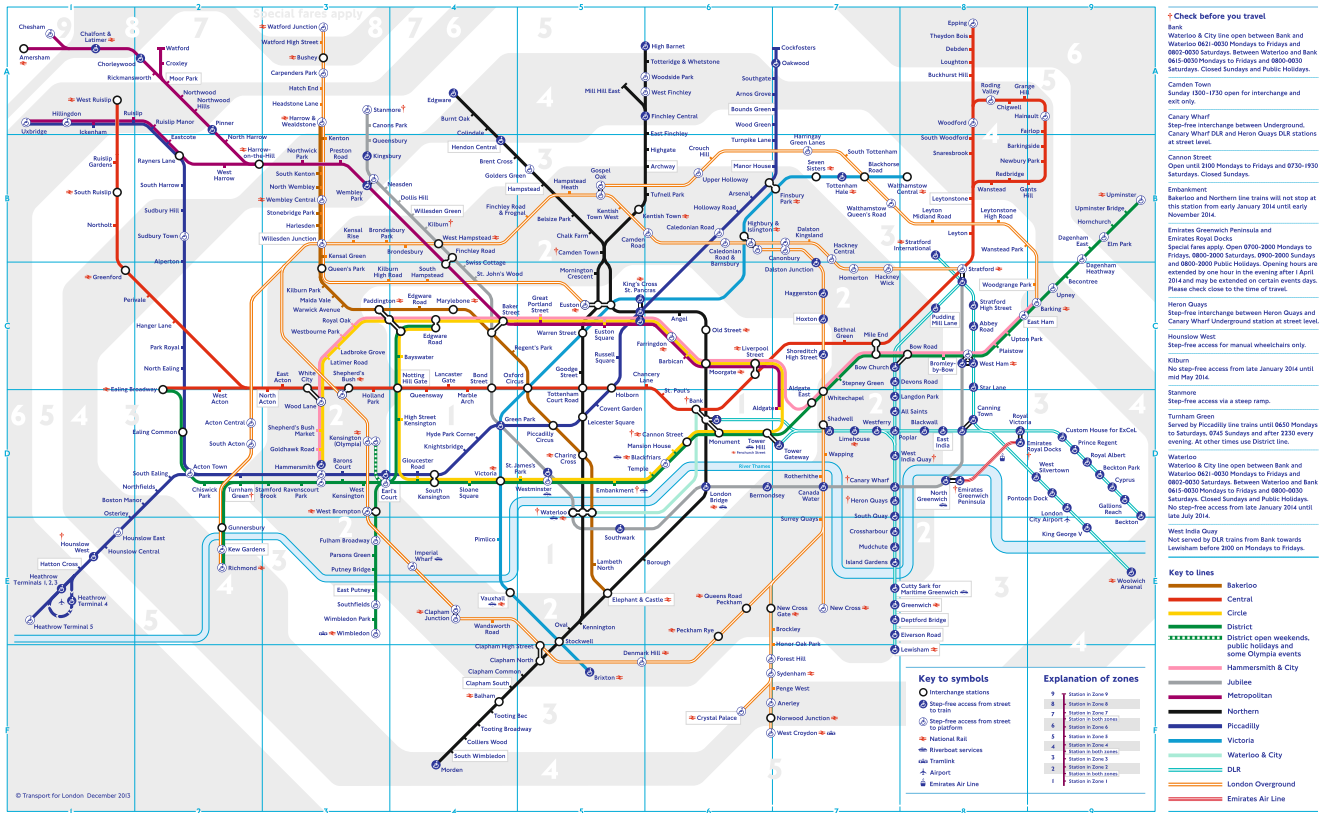


Figure 3. The London Underground Map (Source: Transport for London). [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1111/dmj.12098)]

depending on the individual circumstances of the patient.

3. The London Underground map is broken down into zones, notionally journeys start in the suburbs and move to the centre and back again moving through numbered inner and outer zones. In the PEM approach patients journeys also share generic stages which have been systematically numbered; starting with stage 0, preventing the need for a healthcare intervention in the first place; progressing to stage 2, the initial

trigger; then stage 3, signposting to the right healthcare pathway; then undertaking of an assessment or diagnosis, in stage 4; before initiation of treatment or intervention in stage 5 and then ultimately discharge in stage 6.

4. The London Underground Map sits inside a much bigger Transport for London map that shows interconnecting buses, over ground services and access to specialist services. Likewise, a Patient Ecosystem Map might show healthcare pathways, but

there will inevitably be many other key social care and 3rd sector pathways that have a key role to play in the system as a whole.

5. The London Underground Map shows the transport system as it functions during the daytime and evenings, night-time and week-end services may be reduced requiring travellers to access transport in different ways. In the same way a Patient Ecosystem Map can be created for different times of the day and week, as many healthcare

A high-level visual representation of a system of healthcare that shows.



Figure 4. Icons used in Patient Ecosystem Mapping (Source: Cofink Ltd.). [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

services are unavailable outside the working day and at weekends.

Discussions with healthcare teams also reflected on how contemporary navigation is also informed by Google Maps. From this approach additional interesting principles were derived:

1. In Google maps the traveller can zoom in and out and decide required level of resolution required to navigate a journey. In PEM decisions can be made about the level of resolution required for the initiative that the team want to explore.
2. In Google maps the small yellow figure in the right-hand corner of the map can be dragged into a map to show

street view (effectively a real journey, that was made on a particular day by a Google Camera Van as it drove down the roads in the map). In PEM real patients and their families can talk through their real experiences as they navigated a journey through the ecosystem of care.

3. In Google maps the visualisation is informed by data, this can show journey times and points of congestion to inform both customer journeys and ultimately how a transport system might be improved. The PEM can be used as a focus for exploring what data is available, what data should be collected and how this might inform future improvement strategies.

It became clear that the first step in developing a repeatable PEM approach would be to develop a standardised set of icons and a set of rules for deploying them.

In the same way that the London Underground Map and Google Maps are constructed using a predetermined set of icons and mapping rules, a set of icons and rules were developed to help make the PEM approach repeatable by anybody trained in the approach. This set of icons is shown in (Figure 4). Symbols allow visualisation of where stages of healthcare take place, who patients interact with and the stage in the healthcare journey that they have reached. A map that has been prepared using these icons is shown in (Figure 5). This is a visualisation of the Patient Ecosystem associated



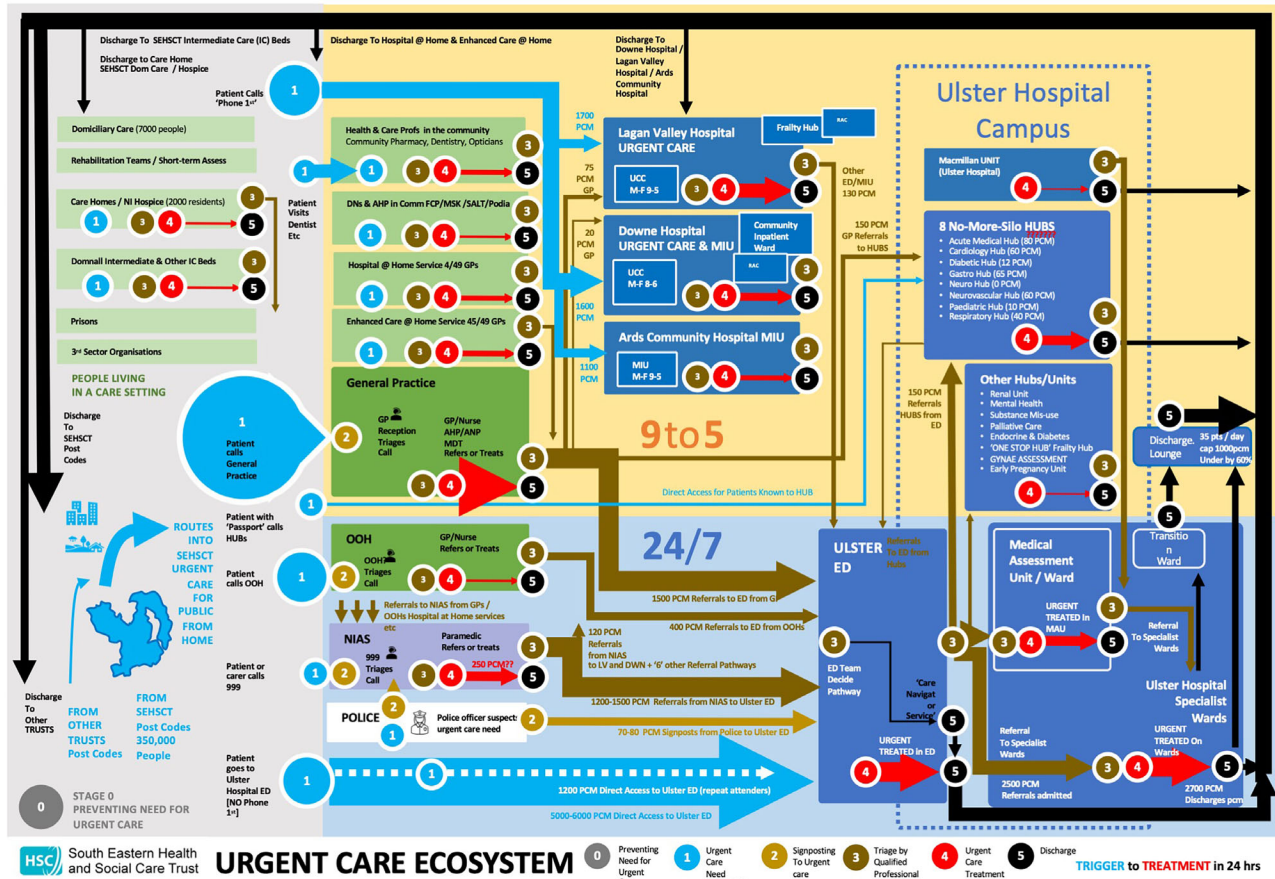


Figure 5. Patient Ecosystem Mapping showing urgent & unscheduled care pathways in SEHSC, Northern Ireland (Source: Cofink Ltd.). [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1111/dmj.12098)]

with urgent & unscheduled care in the South East Health & Social Care Trust in Northern Ireland. On this map some of the arrows that represent the connections between different parts of the system have been scaled to show relative flow rates of patients per calendar month.

### Building and using Patient Ecosystem Maps

Having described what a Patient Ecosystem Map is and how the concept has evolved it is important to

explain how the maps can be built and the function they play in QI in real projects.

Since 2022 the methodology has been used to map a wide range of health care systems in Scotland and Northern Ireland. In each of these projects the PEM approach has been used and then through a process of post-project reflection with key stakeholders the methodology has been refined. This iterative development has now reached the stage where the Patient Ecosystem Mapping approach can be described

as a method that helps a team develop and prioritise system shifting interventions in a healthcare ecosystem. The stages in this process are described below.

*Stage 1: Define scope of the project and mapping exercise.* When starting a PEM project, it is very important to establish the broad aims of the commissioning team. This helps define the scope of the PEM that needs to be developed (and the key stakeholders who will need to be

invited into stage 2 of the process). There are four key dimensions of scope that can be usefully defined at the outset.

- **Geography:** Healthcare is usually delivered in systems that are defined by a geography, this might be the catchment area of a particular General Practice or a community, city or region. Defining this area helps put a geographical boundary on a PEM, although inevitably there is always some ambiguity about how patients access care at the boundaries of a geography (often neighbouring health systems have different ways of caring for patients).
- **Patient / User Groups:** It is useful to define the patients or user groups that will be covered by a PEM, this could be all patients/user groups or a specific demographic (age, sex, etc) or subset with a particular condition or range of conditions.
- **Pathways:** Most healthcare is organised through a range of named pathways or services, it is useful to understand at the outset what pathways are in scope for a PEM project.
- **Service Mode:** Healthcare professionals often cluster care into different modes of delivery according to priority of treatment need, these might be emergency care, urgent & unscheduled care and elective care. Often all three modes of delivery can be running through the same system.

Likewise, most healthcare systems do not operate 24/7 at the same level of delivery. Defining whether a project / PEM is mapping all services, weekday services, or out-of-hours services is very helpful.

*Stage 2: Map the Patient Ecosystem.* Having defined the scope of the project it is useful to define the stakeholders who will need to be involved in the mapping process, there is rarely one person who has complete oversight of how a system works, it is usually invaluable to have input from multiple perspectives, including the various clinicians, nurses, paramedics, allied health professionals, administrators, receptionists & call handlers, carers etc who work within the system as well as patients, their families and carers. In the author's projects this has been undertaken online through 90-minute Teams based workshops supported by a MIRO board or through face-to-face workshops with A1 mapping sheets post-its and pre-cut icons. Often a generic high-level map of the patient ecosystem in a particular locality has been used as a start point, during workshops this has been worked up using local pathway and service vocabulary. During these mapping workshops it is also useful to explore what flow rate data is available that can be 'painted' onto the map. Often a considerable amount of data is available for parts of the map (often

around hospital services), but less data is available elsewhere, ways of collecting and recording data can also be extremely varied.

Building the PEM with the stakeholder group effectively facilitates the creation of a 'boundary object' as defined by Leigh Star & Griesemer, 1989, and Bowker et al., (2015) effectively an abstracted but agreed representation of a complex situation which allows the various actors in the situation to co-operate (despite often having conflicting interests).

*Stage 3: Elicit Patient Feedback.* Once a PEM map has been created it is very useful to run workshops with patients, their families and carers to explore their perceptions of how the ecosystem actually works. Patients can talk through their experience of working their way through the system, effectively giving that 'google street view'. Importantly it is only the patients who will experience all stages of the ecosystem so their perspective is key in understanding how the system can be improved. Useful questions to ask patients include:

- What was challenging during their journey?
- What worked well during their journey?
- What ideas do they have for improving the system?

This stage in the PEM process opens up opportunities to use a wide range of design approaches to help illustrate how the system works from

a user perspective. For example, user diaries, service safaris, user shadowing, user personas and different forms of user journey mapping as described in *Design Methods for Designing services*, Design Council, 2010.

*Stage 4: Identify challenges in the system.* The finalised PEM, and patient insights can then be brought back to the stakeholder team (or a small subset of that group) who were involved in Step 2. Again, this can be done through online MIRO supported or face-to-face mapping workshops. This group can be asked to reflect on the map and consider the problems and challenges across the system of care. When doing this it is very useful to take a systems approach, and ask participants to systematically reflect on the PEM from different perspectives, for example:

- Perspective 1: What are the observable day-to-day challenges within the ecosystem of care.
- Perspective 2: What are the trends (with data) that are having impact on the ecosystem of care over time?
- Perspective 3: What are the structures, systems & interfaces that create challenges in the ecosystem of care?
- Perspective 4: What are the mental models, mindsets and policy decisions that influence behaviours of both staff and patients within the ecosystem?

- These four perspectives are derived from the iceberg model developed by Donella Meadows to show how a system is influenced by factors with different levels of leverage (Meadows, 2008)

*Stage 5: Plan System-Shift.* After a clear set of challenges has been identified within the existing system the stakeholder team can turn their attention to translating these into opportunities for improvement. A step-by-step approach can be used to choreograph an online or face-to-face workshop to facilitate this conversation.

- First of all, it is very important to get agreement on what the core aims of a future improved system might be.
- It is very unlikely that a singled improvement project will deliver on all the challenges identified in the system. Instead, the team will need to develop a 'system shifting' portfolio of potential improvement projects. It can be useful to record each of these as 'How-Might-We' statements, effectively creating a set of 'mini briefs' to guide system improvement.
- If time is available, it can be useful to use the PEM approach to model what a preferable future system might look like. Having this representation can act as a

'polestar' to help see what the impact of a portfolio of interventions could be over time.

- Finally, the team needs to think through how improvements should be prioritised and sequenced to drive through the required system change.

The concept of system-shifting has been derived from recent writing by, Van der Biji-Brouwer, 2023, in which she describes what systemic designers do by defining different levels of intervention that a design intervention can be made in a system. This concepts of levels has been translated into a healthcare context in Figure 6789 which shows how improvements can be made in healthcare. This diagram illudes to the fact that most of the improvements that are made in healthcare are typically made at Level 1 and Level 2. Interestingly the PEM approach enables a level 3 intervention to be made which will require greater collaboration across the system but will inevitably have a greater impact.

*Stage 6: Deliver System-Shift.* Once a plan has been established for shifting the system thought must be given to how to deliver change. This is an interesting challenge in a complex healthcare systems in which there may well be multiple entities with their own management responsibilities. One interesting model of change that does seem to fit within this situation is Kania & Kramer's model of Collective

**NOTES:**

**Level 1** = How a majority of healthcare improvement is currently delivered

**Level 2** = Improvement activity that understands system consequences

**Level 3** = A high impact approach for cross-system improvement

**Level 4** = A speculative position which can help guide **Level 3**

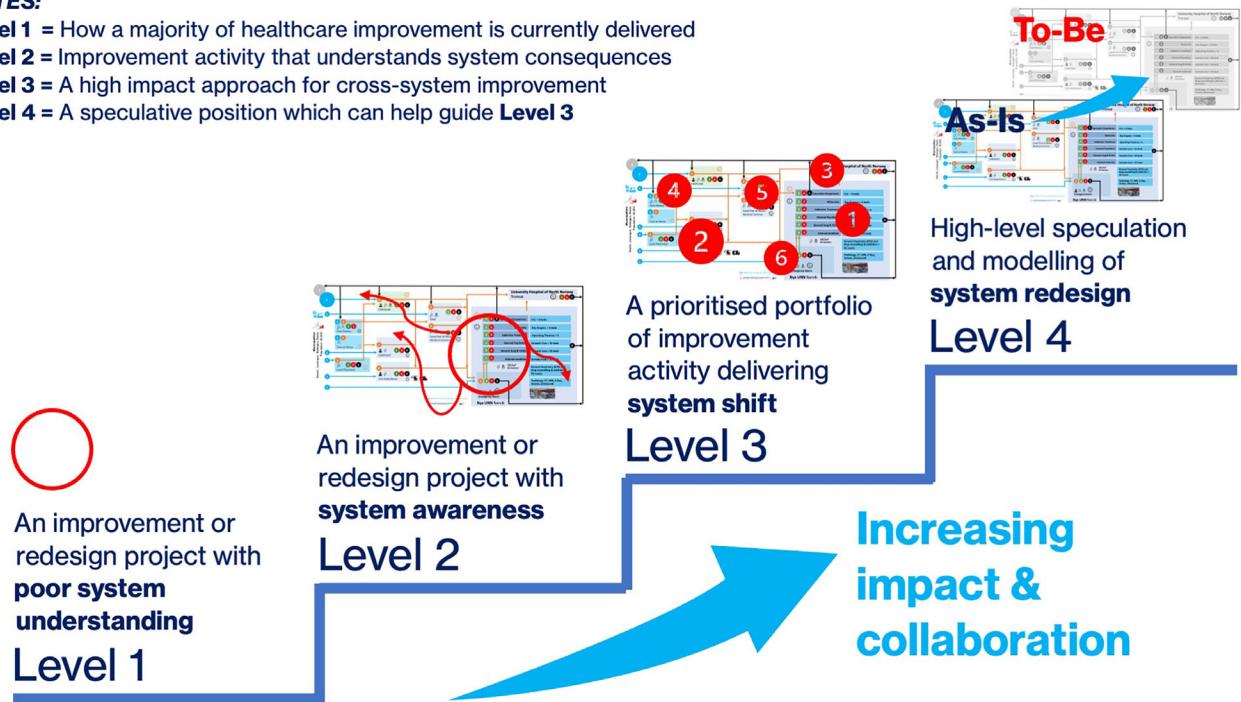


Figure 6. Levels of intervention into a healthcare system. [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

Impact, Kania & Kramer 2010. This suggests the establishment of a change initiative across a complex system with all participating stakeholders and organisations signing up to:

- Agreed initiative aims.
- Agreed measures of progress.
- Pooling of expertise.
- To make the change initiative succeed Kania and Kramer suggest the establishment of a back-bone organisation charged with:
- Celebrating the successes of projects and activities when progress is made with system improvement.
- Being politically adept to ensure support for all projects within the system-shifting initiative.

- Drawing down resources as required to deliver the project portfolio.

**Case studies**

To date the PEM approach has been used in over a dozen projects with different health boards and trusts across Scotland and Northern Ireland, and training in PEM has been delivered to healthcare professionals from Scotland, Northern Ireland, Norway, Denmark, Canada and Australia. 3 mini case studies describing application of the approach are described below:

**Domiciliary Care (Care at Home) Services: South East Health & Social Care Trust**

A detailed Patient Ecosystem Map for Domiciliary Care was built up through five 90-minute online workshops with over 60 participants. During a series of one-day face-to-face workshop service user journeys were mapped, challenges were explored, and a portfolio of improvement projects social, primary & secondary care were identified. See Figure 7.

**Commissioned Services: NHS Tayside & Angus HSCP Care Trust**

Detailed Patient Ecosystem Maps were built for a range of newly

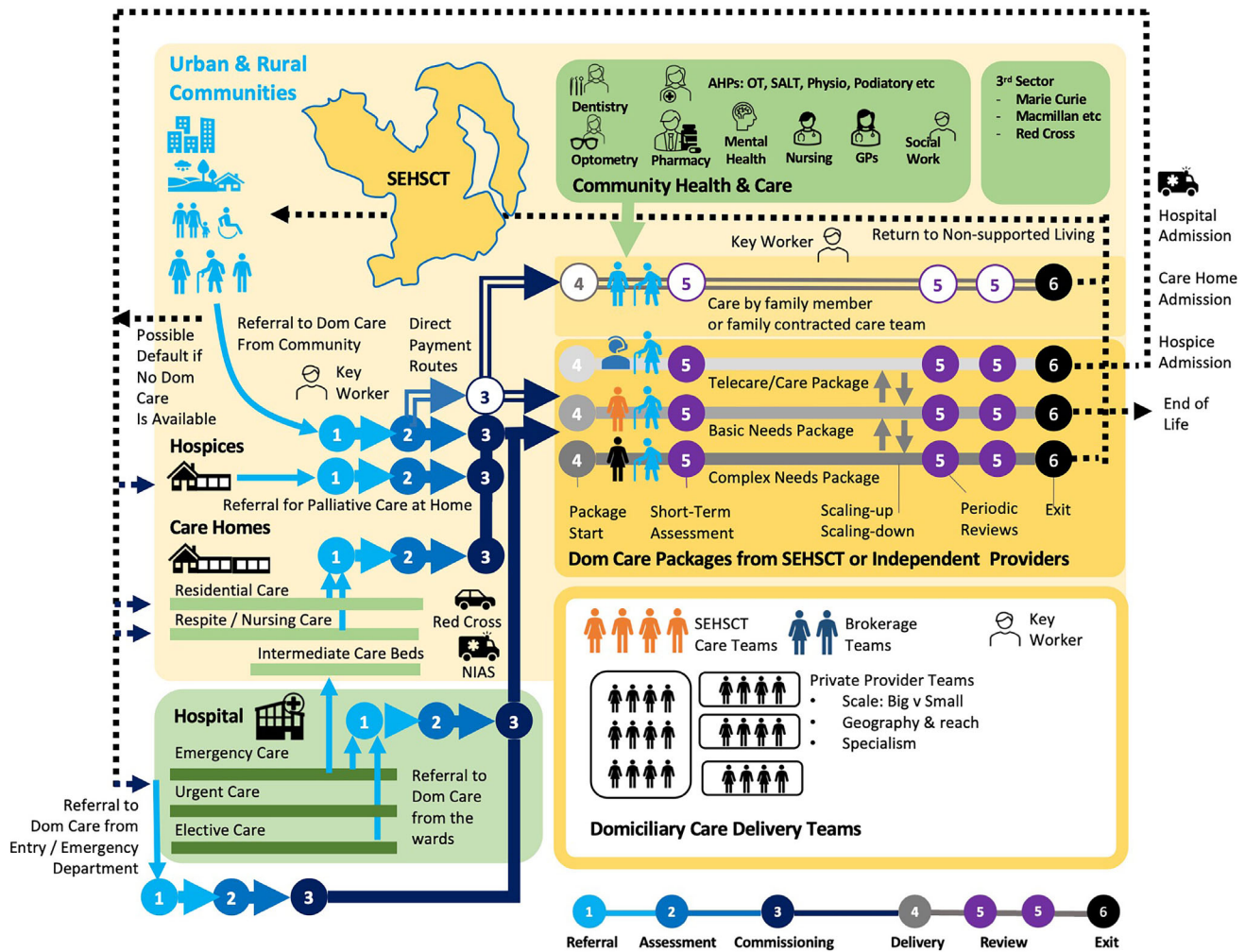


Figure 7. Patient Ecosystem Map: Domiciliary Care, South East Health & Social Care Trust, Northern Ireland (Source: Cofink Ltd.). [Color figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

commissioned services established to alleviate pressure on General Practice, (in response to revisions to the 2018 GMS Contract), these included Social Prescribing, Pharmacotherapy, CTAC and First Contact Physiotherapy. The maps have been used to inform potential improvement projects and more effective ways of monitoring service performance. See Figure 8.

**Scottish Clinical Genetics Service: All NHS Scotland Regional Boards**

Through a series of online and face-to-face workshops Patient Ecosystem Maps have been built for Scotland’s 4 regional Clinical Genetics Services (West, North, South & East). The maps have enabled the teams to communicate the role of Clinical Genetics to other stakeholders at a regional and national level. Variance in

regional delivery strategies has been mapped – information that is helping in the development of National Service Specifications. See Figure 9.

**Conclusions**

The PEM approach has been developed through a process of practice-based research with the author working as both information

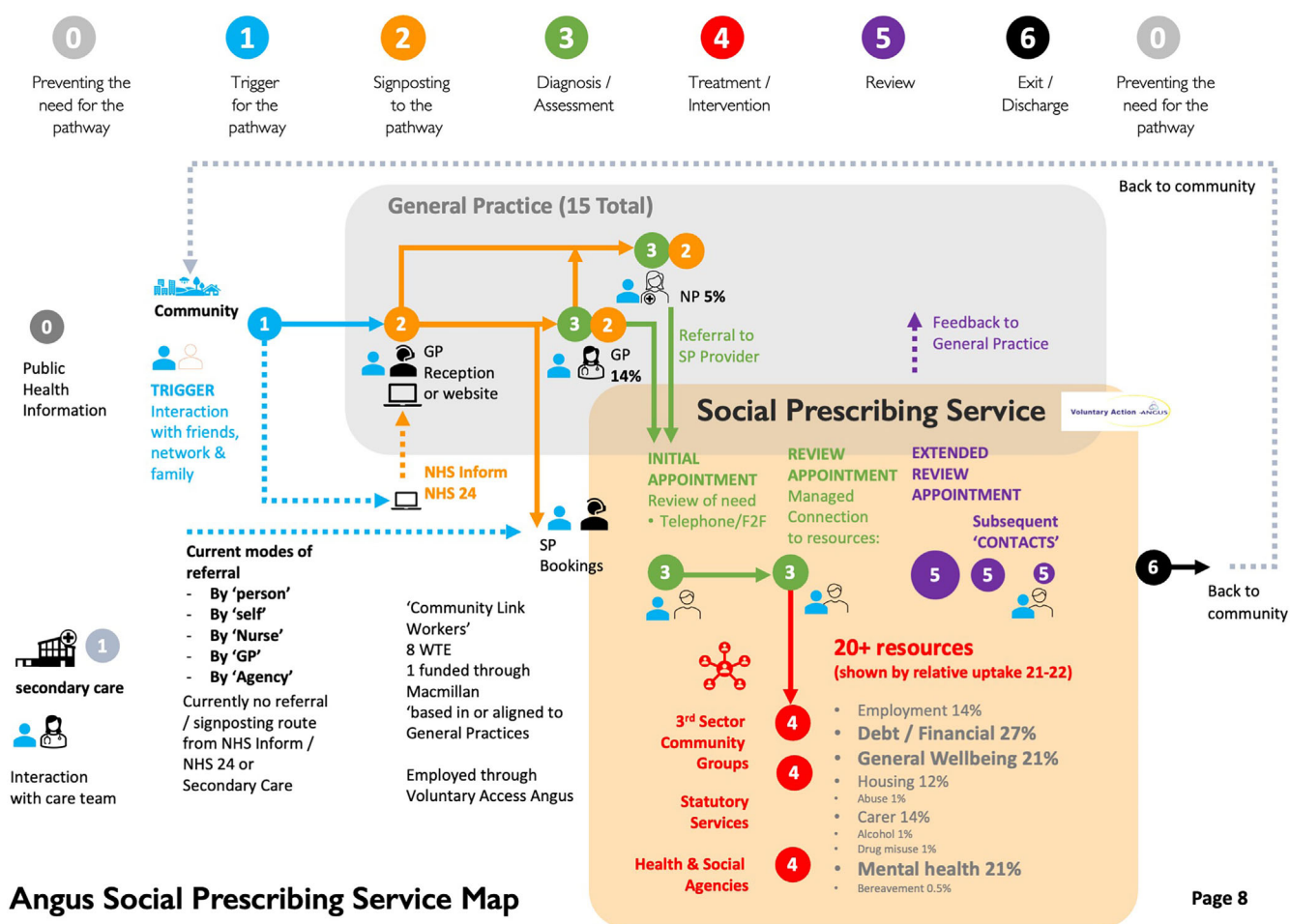


Figure 8. Patient Ecosystem Map: Social Prescribing, Angus HSCP (Source: Cofink Ltd.). [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

designer and researcher within a wide range of healthcare teams. The method has now been codified and framed within a process of change involving six steps. There are many methods in play for mapping processes and pathways in healthcare, the PEM approach does have a number of attributes that set it apart from established methods, most noticeably the way it builds a shared co-created representation of a system of care with key stakeholders, the way it takes a patient perspective that

can be used to help structure feedback on patient journeys and the way it encourages a portfolio of improvement projects that can potentially result in the system-shifting now being demanded by the challenges that face healthcare systems.

### Future developments

The PEM methodology is now being used as a research approach within two research projects that have

recently been awarded to the Department of Design, Manufacturing & Engineering Management (DMEM) University of Strathclyde.

The first project, SEISMIC SHIFT (Systemic Health Innovation Future Transformation), funded by the National Institute for Health Research and the Engineering & Physical Science Research Council, is a partnership with NHS Highlands and NHS Lanarkshire. The work is exploring how computer-based

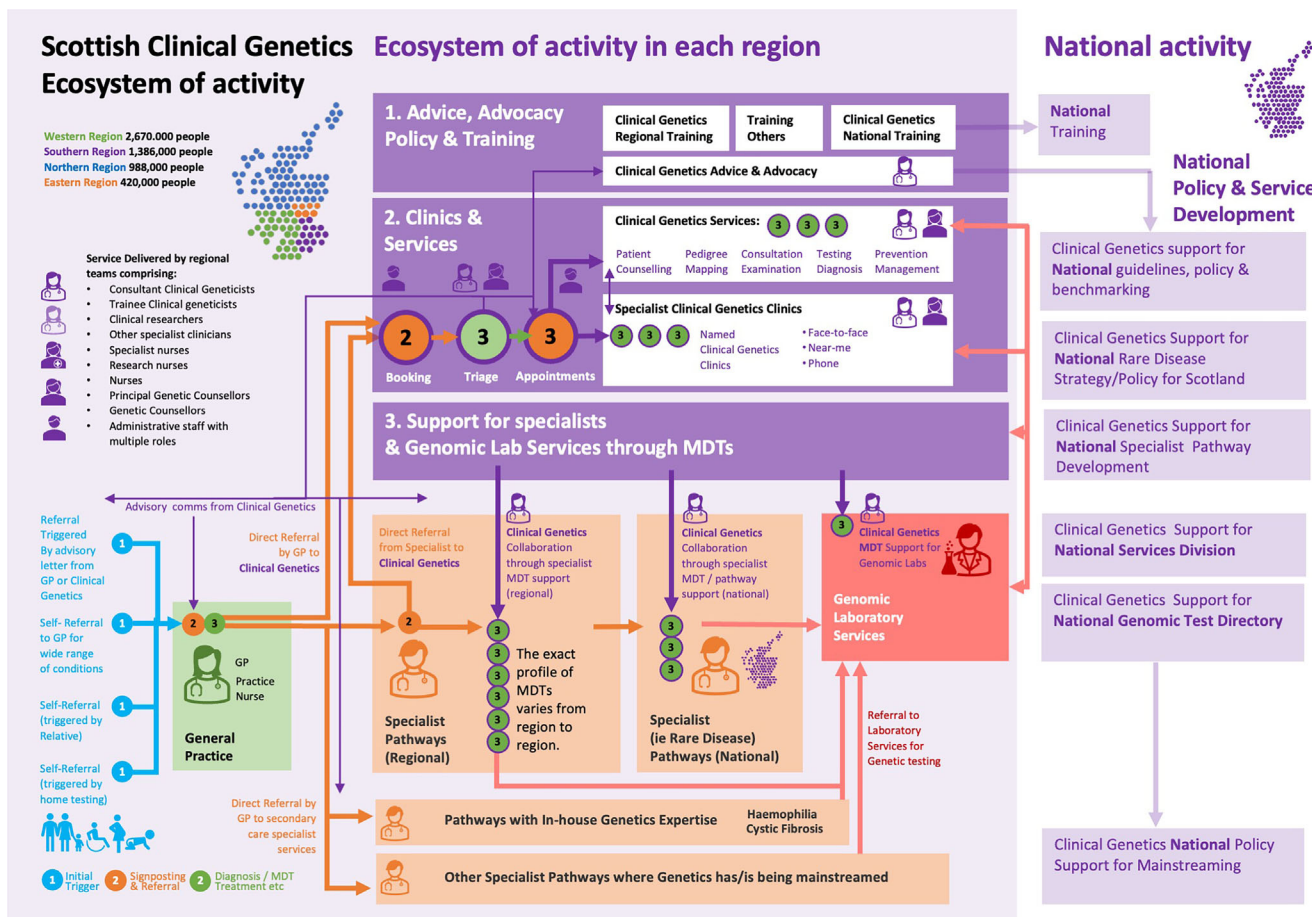


Figure 9. Patient Ecosystem Map: Scottish Clinical Genetics (Source: Cofink Ltd.). [Color figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com/doi/10.1111/dmj.12098)]

engineering system models can be developed for patients with Multiple Long-term Conditions. The PEM approach has provided a valuable first stage in developing data driven models of care.

The second project, Design HOPES, funded by the Arts & Humanities Research Council, is focused on developing more sustainable approaches to healthcare delivery, in this project the PEM approach is being rethought to help visualise the ecological dimensions of healthcare flows. Key research

questions in this exploration include:

1. Can the PEM approach be used to build a high-level visualisation of the carbon footprint of patient flows through a healthcare system? Version 1 of PEM described in this paper allows relative flow rates of patients (usually measured as patient per calendar per month) to be visualised, how could the approach be adapted to map out

carbon load per patient per calendar month through the system.

2. Could the flow of other elements within a healthcare system (such as materials) be mapped using an adapted version of PEM?

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