Digital Dermatology Mapping Report

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A report by:

Digital Health & Care Innovation Centre

Prepared for:

Centre for Sustainable Delivery | NHS SCOTLAND | AI skin cancer consortium

Purpose of report

This report presents the findings of a clinical engagement and co-design process that mapped and analysed current, possible, and preferred future state methods for the referral and vetting elements of a digitally enabled dermatology model.

The broader programme aim is to optimise the dermatology referral process at every stage with image capture. It will deliver image capture as close to the patient as is appropriate, using optimised processes and artificial intelligence as is available. It will improve triage, diagnostic accuracy and inform optimal treatment options which are delivered in the most appropriate care setting in a timely way across the whole system.

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Introduction

Timely patient referral, triage, diagnosis and commencement of treatment are key drivers of successful patient outcomes for a wide range of dermatology conditions, including skin cancer.

Advanced Clinical Referral Triage (ACRT) has become a key tool in the NHS Scotland recovery programme. The ACRT core principle is the vetting of referrals to a service by experienced clinicians, allowing referrals to be directed not only to standard clinical pathways but also to virtual clinics and advice only (to the patient and/or referrer). Many Dermatology departments have or are adopting ACRT but it is well recognised that there are limitations where decisions are based on a free text description, particularly with lesions. The use of image capture at referral, which can then be used for ACRT within secondary care (as well as follow on asynchronous consulting), are key enablers of providing a timely service to patients referred to Dermatology.

There is significant scope for benefit for many other services as well, within the time constraints of this work these have not been explored in detail: In particular ensuring future-proofing digital architecture to support potential separate work in relation to the primary care stage of the pathway.

Across Scotland, whilst some Boards currently have close to 90% of all Dermatology referrals including images of a quality to aid triage, diagnosis, or pathway decision, whilst in other Boards it is only around 20%, creating significant unwarranted variation. This is especially important, as there are long waiting times for secondary care Dermatology consultation in many parts of Scotland, which have been exacerbated by the pandemic. Through the new Innovation Adoption Pathway process, and in line with the Scottish Government's Once for Scotland approach to implementation, there is the opportunity to develop a National Digital Enabled Dermatology Pathway to bring the benefits of image capture, referral, triage and asynchronous consulting to patients across all of Scotland.

In addition, the Dermatology AI Consortium is leading an exciting programme of innovation that brings together industry, academia and other partners with NHS Scotland to utilise machine learning and AI to achieve an ambitious target of diagnosing skin cancer in 25 min by 2025 (the 25 x 25 Moonshot challenge). This ambition has the potential to transform outcomes for people across Scotland with suspected skin cancer and to support the development of the Scottish life sciences industry. A key enabler for this work is to develop a safe and effective flow and storage of triage quality skin lesion images and other data to aid machine learning required to achieve this objective. The AI Consortium is already scoping the design of models of care and technical standards, architecture and functional requirements for this within three NHS Boards.

The Innovation Adoption Collaborative and the AI Consortium are now aligning efforts to develop a shared Value Case for the development of a National Digital Enabled Pathway for referral, triage and asynchronous consulting within Dermatology. The development of such a pathway will deliver significant value to patients and clinicians across Scotland, including:

- The ability to triage patients to the best care pathway at the time of referral
- Reduced need for dermatology specialist face to face appointments where alternatives can be delivered more quickly, conveniently, and as safely
- Reduced waiting times for high priority patients to access an outpatient appointment (long wait times is a particular issue for Dermatology post pandemic)
- Convenience for patients and the potential for selected patients to access tailored self-care advice remotely
- Ability to remotely monitor disease progression

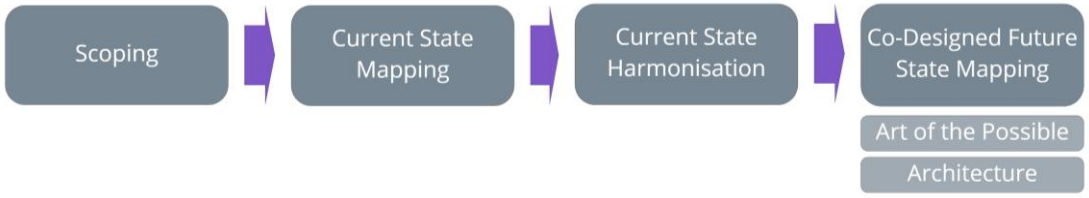
The pathway will also have the added benefit of greatly increasing the number of digital images available to the AI Consortium to aid machine learning. Two of the key elements in generating a value case are:

- An agreed national referral, triage and asynchronous pathway that is endorsed through clinical consensus across Scotland.
- A specification for the digital elements supporting the pathway, leading to a procurement process to identify the best provider(s), based on fit with requirements (both from a national pathway and AI Consortium perspective) and value for money.

This paper outlines the engagement and codesign work undertaken to develop a national preferred future state model and advisory material to develop the technical specifications.

Methodology

The project method followed an accelerate version of DHI's normal visual mapping / codesign method.



The steps included:

1) **Scoping -** Initial scoping was carried out between DHI, CFSD and stakeholders across Scottish Government and NHS Scotland. The agreed scope was the service journey encompassing referral from primary care into secondary care vetting.
2) **Current State Mapping** – the team ran interviews across ten Scottish territorial health boards. DHI attended to capture visual maps to compliment the CFSD questionnaires.
3) **Current State Harmonisation** – the team reviewed the maps and questionnaire responses and developed a single image depicting the common and variable elements across the ten boards.
4) **Co-designed Future State Mapping** – the team organised national co-design workshop activity to review the harmonised map and then develop a preferred future state service model. In addition to the service design elements, two other strands of activity were included:
    a. **The Art of the Possible** – the DHI team was asked to reflect on other digitally enabled service re-design from a cross the NHS, in order to stimulate the clinical stakeholders to be able to stretch and consider how to scale and sustain similar methods.
    b. **Architecture –** There was focused discussion at each stage around the separation of data (storage, sharing) from the products, interfaces and experiences at various stages of the pathway. 'Platform' thinking was encouraged to ensure any output could be progressed without dependency on any one product or technology, and that the developed service could reuse common platform components shared with other similar services across the NHS, to support sustainability and scalability.

Current State

The following current state map was drawn from ten health board service maps and questionnaires. For an example of the current state maps, see **Appendix 2**.

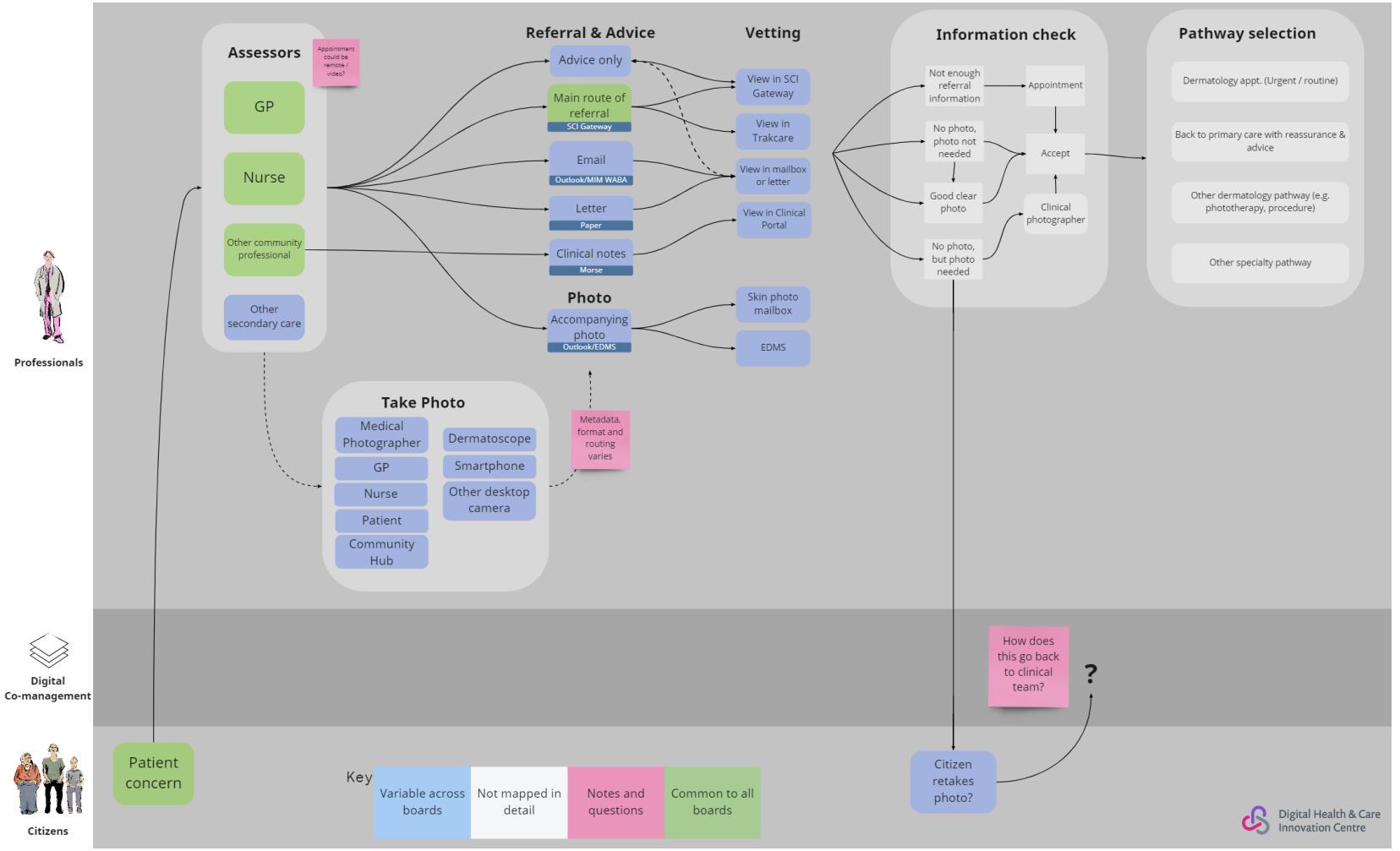


Figure 1: A harmonised current state map covering ten health boards.

In this current state model (**Figure 1**), there are several areas for improvement, including:

- The multitude of ways that photos and information is sent to and between professionals in the different tiers of care.
- The differing sources of photos and mechanisms for photo capture and storage, all working to different standards (or none).
- The lack of capacity, skills and assets for these activities in primary care.
- The lack of efficient options for secondary clinicians to enhance the photo / referral information they receive.
- The lack of governed, safe methods for citizens to submit photos, information and engage in dialogue or data sharing outside of appointments.

However, the variation across health boards appears to be a result of the different levels and choices of assets and technologies, rather than any substantive difference of intent and method.

Common User Requirements

At the beginning of the professional co-design sessions the group was asked to reflect on the common requirements for their kind of service from a patient's point of view.

DHI offered the accrued insights from nine years of health and care co-design (a review is published here). The dermatology workshop participants then, reflecting on their own clinical practice, voted for the user requirements that were most applicable to the nature of the pathway. The top five, in order were:

As a citizen co-managing health and care services I want to be able to:

1) Trust in how others use my personal information,
2) See a timeline or route map of my care interactions and understand their content and purpose,
3) Have an ongoing dialogue with professionals outside of formal appointments, allowing me to ask questions on my own terms,
4) Use my own technology to access services and monitor myself to support my own care,
5) Share my experiences and outcomes - and for this to improve care for myself and others in the future.

The general themes, shared by many other services and specialties, is that citizens can and will play a more active role in their own care – through monitoring, self-assessment, and use of their own technologies, if they are given the power to do so and they feel they have control over the use of their personal information.

Preferable Future State

Figure 2 below outlines the output of the co-design sessions with clinical teams across Scotland. **Appendix 3** contains a larger map with some additional insights.

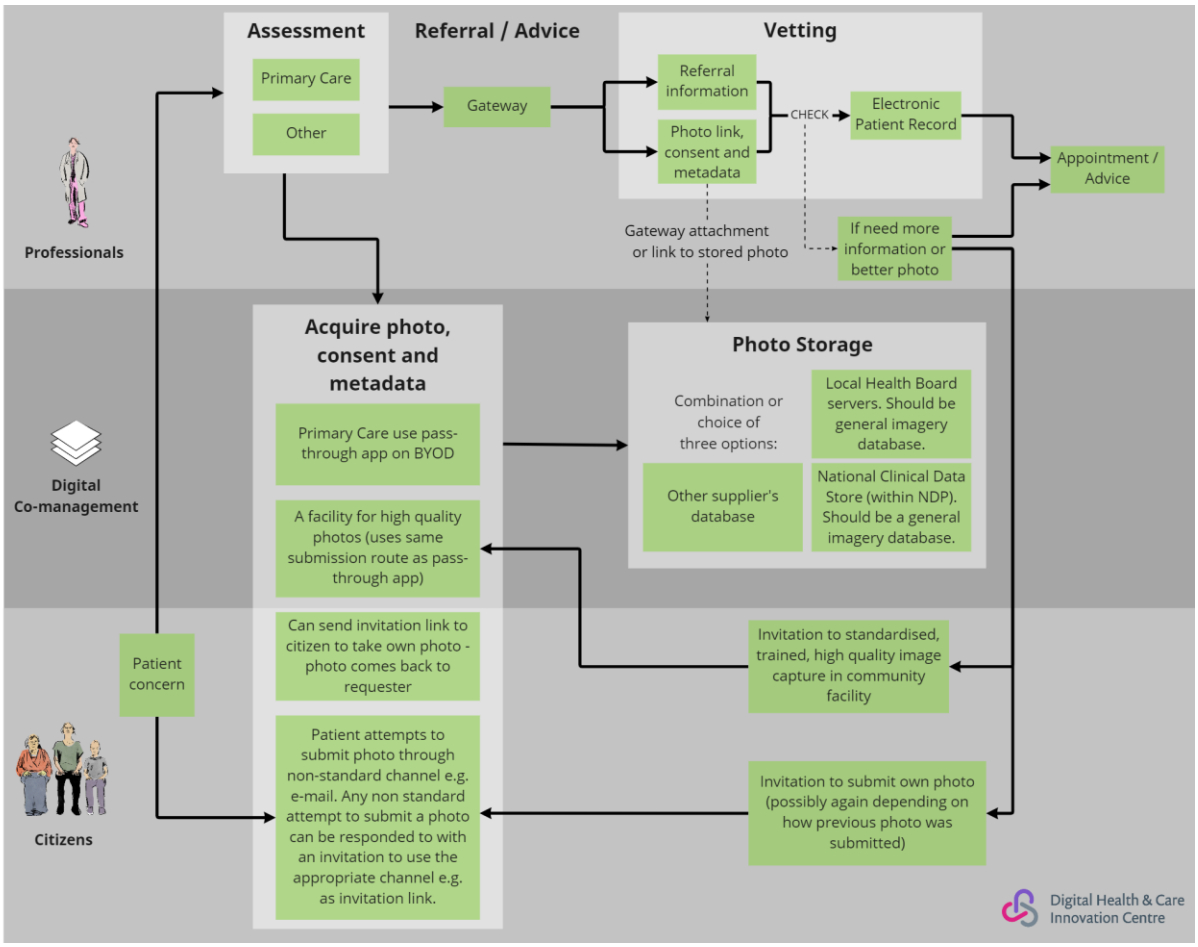


Figure 2: The preferred future state as described by participants at the DHI workshop.

In this future state service model for referral and vetting:

1. **Initiation –** when a citizen is concerned, they can attend a primary care appointment where a professional will take a photo as needed, using a personal smart phone with a governed, DICOM standards compliant photo capture and pass-through (PCP App).
   In some cases, they will attempt to email or message in photos, at which point the GP practice sends them a link to a patient version of the PCP App and asks them to retake the photo and add some additional information using the app.
   Over time, and if primary care pressure increases, there is an option to give patients direct or qualified (e.g., NHS 24) access to the PCP App.
   As Community Diagnostic Hubs (or alternative photo capture locations / services) are established, they will need a version of the passthrough app and may handle direct access by patients or give qualified access to the patient PCP App.
2. **Referral –** when referring the images (and metadata) are attached to a SCI Gateway referral or link to the photo in common, standards-based (DICOM) data store.
   Alternatively, in some cases the PCP App could allow for referral data to accompany the photo into the store, and this could directly populate the vetting interface used by secondary care.

If the patient has pre-submitted photos, the clinician can access these and use for the consultation and referral. This may mean in the future that in some cases the patient does not need to attend the GP practice physically.

3. **Vetting –** the secondary clinician sees the referral information and photos side by side within one interface. This vetting interface should be able to check referral record / photo completeness to visually indicate on a dashboard which records are fully ready for vetting.
   The clinician could have workflow tools in the interface to flag actions, record decisions and take notes. The core actions would be:
   a. Accept into clinic and arrange an appointment (F2F, video or async)
   b. Give advice back to primary care as requested (in the short term by sending a summarised vetting record and notes through to Docman, but there may be an asynchronous digital communications method in the future).
   c. Attempt to enhance the readiness of an incomplete referral through a mixture of:
      i. Arranging an appointment to better understand the patient's situation
      ii. Arranging an appointment with a clinical photographer
      iii. Activating asynchronous consulting tools early to enable a two-way dialogue with the patient remotely to better understand patient situation
      iv. Asking the patient directly to submit new or better photos.
4. **Ongoing Care –** the clinician (and in future patients) should have access to the records and photos throughout the process and during ongoing care. There should be smooth handover between the photo submission, vetting and asynchronous clinic tools using common identity and consenting methods to support a better user experience for the patient. Ideally there would be some sort of timeline / journey view for patients to better understand the pathway.

Foundations

Some key 'foundation' elements of this model are further defined and discussed below. These are 'must haves'.

1. **BYOD (bring your own device) -** A key driver of this pathway innovation is phototriage without additional pressure or burden on Primary care. Hence the solution is not widescale distribution of dermatoscopes to Primary for the sole purpose of this pathway. Where image quality is not considered adequate to manage the referral, then there should be routes open to them that do not mean a default back to the general practitioner.
   GPs would prefer a BYOD policy using a pass-through app that does not store the photo to preserve privacy and address security considerations. Generic readily available devices like this are preferred over specialist equipment, which in previous attempts has always gone unsupported and unused. BYOD is a wider policy issue that needs to be addressed – but for reference NHS England has shifted its guidance to accept its use.
2. **Photo capture and pass-through app (PCP App) -** A PCP App takes a photo and allows for metadata entry. The image exists only within the app until the device is connected to WIFI. It is then sent onwards and deleted from the app.
   PCP Apps used in primary care is the preferred method of submitting photos. Of paramount importance is an agreed standard for image format and metadata i.e., DICOM format was suggested but we still need to agree standard metadata set.
   SCIT, WABA, Panda and ARCHIE were suggested as example PCP Apps, but they differ in standards and functions and no agreement was found. An options appraisal is required here.
   PCP Apps are in use in some boards but will require IG work in other boards.
3. **High quality community image capture -** There needs to be an option for standardised, high-quality photography using dermatoscopes at some point in the pathway. The systems

developed in the pathway need to support / take account of Medical Photography services where available and have the potential for development of local community image capture centres. In Figure this is shown as an option if an existing photo is not of sufficient quality for diagnosis in secondary care. In future there would be an option for citizens to go straight to such a facility if desired or requested by primary care.

4. **Standard national photo storage -** A standardised national image storage is preferred. Standardised national storage options would require resource. This is in the current scope of the National Digital Platform, but timescales are unknown.

There are some remaining service design elements that require further discussion and specification, but these are dependent on some platform decisions areas outlined in the next section.

Service Development Roadmap

There are several, core requirements from clinicians:

- GPs need to easily take / share photos and refer
- Other actors (citizens, community hubs, medical photography) need to take / share photos to supplement referral, and on demand by secondary care teams (with appropriate support for citizens not able to take photos themselves or access hubs)
- Secondary care teams need to be able to review referral and photo data in one interface
- Secondary care teams need to be able to request a new or replacement photo from citizens and community hubs
- Secondary care teams need to be able to start asynchronous consultations with the patient at either vetting or clinic stages

The clinical teams reviewed the common user needs arising from DHI's broader co-design portfolio. Their view of the most pertinent patient requirements included:

- Citizens need to be able to see where they are on the journey and access and update records as appropriate
- They need to be able to maintain control over the use of their personal data and to do this is a common way across multiple services (identity, consent, withdrawal of consent and access to guidance in these decisions),
- They need to have the option use their own technologies (in this case smart phone cameras and apps) to take part.

Further work will be undertaken to gather patient input as the pathway is further developed.

Some of the future state service and associated requirements can be met through software and hardware applications / products. For example, for the interfaces for photo capture and passthrough, for vetting workflows and for subsequent asynchronous communication and clinic tools. Many suppliers may provide these capabilities, and they can be regarded as modules in an overall system that can re replaced and refreshed relatively easily over time.

There are a more fundamental set of decisions required around the underpinning digital platform(s) for referral and vetting (standards-based photo, meta data and referral data storage and sharing), and for asynchronous patient interactions (identity, consenting, data sharing, clinical system integration). These decisions should be arrived at in a manner that delivers on the short term needs around referral and vetting, but that also enables extension over time to optimise the end to end digitally enabled pathway and other community photo capture and sharing services as they emerge. **Appendix 1** outlines DHI recommendations for a developmental roadmap to help in this regard.

Appendix 1 – DHI Recommended Roadmap Development

The following outlines the DHI view of a potential road map for development of the systems to achieve the outputs described in the workshop.

Figure 3 below outlines the technologies (apps in green, platforms in blue) that can meet some or all these requirements.

Type	Technology	GP take photo	Citizen take photo	Community Hub take photo	GP refer	GP share photo	2nd care review	2nd care request new data / photo	2nd care async comms with patient (vetting)	2nd care async comms with patient (clinic)	Standardised AI training images	Patient view of timeline / journey	Patient common identity and consent control	Patient use of their own technologies
Apps	Pass through app													
	Vetting dashboard													
	Async clinic tools													
Platforms	SCI Gateway													
	TrakCare													
	Health Data Exchange													
	National Data / Media Store													

Figure 3: Requirements mapped to different technologies

No one technology can deliver against all the requirements. Even if one technology could be specified and procured for dermatology, the siloed development of capabilities otherwise achievable at platform level that meet common requirements across many specialties would be duplicative and unsustainable.

Overall, any specification must recognise the need for separate, but interoperable technologies for:

- User experiences for data collection, review, workflow, etc. (e.g., pass through app, vetting and async clinic dashboards)
- Existing platforms that support well understood, governed management and transfer of data and patient administration workflows (e.g., SCI Gateway and TrakCare).
- Emerging platforms used at scale that store and share data separately from any given proprietary product (e.g., National Data / Media Store) and that mediate consistent, trusted patient-clinician communication and data exchange (e.g., Health Data Exchange).

Figure 4 describes three horizons of development and implementation starting with simple, lower effort and risk deployments alongside some future facing platform decisions that will allow the service to grow towards an integrated end to end service.

	Horizon 1	Horizon 2	Horizon 3
Requirement	GP attach photo from Pass through app to SCI Gateway. 2nd care view in an enchanced TrakCare vetting interface. Use of seperate async clinic tools. Pass through app also stores all photos centrally for AI training.	Pass through app updates national media store directly. GP SCI Gateway referral points to store. Store data (photo and referral) viewed in a new vetting interface. Use of separate async clinic tools.	Pass through app updates national media store and GP or other service initiates referral. Patient is invited to engage digitally pre or during referral and creates an account. Stored data (photo and referral)is viewed in new vetting and patient interfaces. 2nd care team can two-way message with and ask for data / photos from patient at both vetting and clinic stages using a common set of asynchronous tools.
GP take photo			
Citizen take photo			
Community Hub take photo			
GP refer			
GP share photo			
2nd care review (image / data side by side)			
2nd care request new data / photo			
2nd care async comms with patient (vetting)			
2nd care async comms with patient (clinic)			
Standardised AI training images			
Patient view of timeline / journey			
Common identity and consent across journey			
Integration of patient's own technologies			
Notes	GP only route due to dependency on SCI Gateway (which may be refreshed soon). Focus on changing existing core systems and procuring dermatology products.	Possibilities of centralised data store being used to accept new types of referrals or request new / replacement photos and data from other additional sources. A blend of NHS infrastructure development and dermatology specific product procurement.	Service no longer uses SCI Gateway for most referrals for dermatology. More focus on using and developing NHS infrastructure and less on procured dermatology products.

Figure 4: Requirements mapped to different horizons of development and deployment

In all these Horizons the four 'Foundation' elements are all standard – A Photo Capture and Pass-Through App can be used on a BYOD basis, storing data in a standards based national data store, with facilities available to capture high quality imagery in the community and send it through to the same data store. A key expectation of all three horizons is that AI development will be supported at each horizon, with AI increasingly being implemented and supporting the pathway; this is not described in detail below as it is subject to separate development by the AI consortium workstream.

Horizon 1: Core System Focus

Continue to focus the development on existing core clinical systems. These systems are typically very restrictive and difficult to change – which has led to next generation clinical interfaces for things like asynchronous clinics being run as web apps launched from core systems rather than being confined within them. Horizon 1 would attempt to evolve multiple instances of SCI Gateway and TrakCare to allow for higher resolution image transfer and 'side by side' photo and referral data review.

The PCP App allows upload to SCI Gateway to attach to a photo, and to store the images in a database designed to support AI training and other R&D. In this scenario the ability to take and share images is closely tethered to the GP's ability to refer through SCI Gateway, making it difficult to get photos and referral data / further context from other sources.

The asynchronous clinical tools used later in the pathway for some patients remains disconnected from this referral and vetting method.

Although this horizon will represent an improved pathway and increased access the system remains opaque from a patient perspective with limited knowledge of where they are in the pathway and no access to, reuse / control of personal data beyond initial submission. This means the patient remains relatively passive in the process, and less likely to be able to co-manage effectively with clinical staff and therefore be more reliant on clinical time.

Horizon 2: Store Focus

This model continues to rely on SCI Gateway but allows links to be embedded in the referral that can allow direct access to the photos and data held in the national data store. This creates a 'single version of the truth' with multiple systems reading and writing from a core record as per the National Digital Platform strategy. With the data liberated and API accessible in this way, a new vetting interface that launches from TrakCare can read and write to the data store, giving far greater flexibility in the clinical experience.

This could then allow for additional patient and community photo hub / diagnostic hub interfaces onto the same data store, which could in turn create an ability for secondary care clinicians to request updates or new / replacement photos without additional appointments.

The asynchronous clinical tools used later in the pathway for some patients remains disconnected from this referral and vetting method.

From a citizen's perspective, as with most NHS methods now, the system remains opaque with limited patient pathway knowledge. There will be some improvement to the reuse of patient data (the data store as a 'single source of truth'), and more opportunities to digitally self-serve, helping to reduce default access to clinical time in some cases.

Horizon 3: Whole System

In this model, the photo capture, referral, vetting and asynchronous tools are all modules in one end to end system designed and built on top of a National Data Store (common data storage, sharing,

reuse) and a Health Data Exchange (HDE - common identity / login, consenting and patient-clinician data sharing). Note the current asynchronous service is already built on top of a Health Data Exchange that is common to COPD, heart failure and covid services also.

Pass through apps used by a range of actors can update the national data store and GPs or other services can initiate a referral from within the app. There will be the opportunity for some patients to engage digitally pre or during referral and may create an account. Once this digital identity is created – both the patient and the clinician unlock improved digital access and communication throughout the pathway. (These approaches need to be developed with appropriate consideration to the need for timely engagement with regards to cancer patients).

Stored data (photo and referral) can be viewed in new vetting and patient interfaces. The secondary care team can two-way message with and ask for data / photos from patient at both vetting and clinic stages using a common set of asynchronous tools. The end-to-end nature of the data store and the patient-clinician data sharing platforms means that the patient can view and understand their status on the pathway / timeline in a coherent way.

This flexible, platform focused approach means that as pressures and needs evolve, so can the estate of connected apps and modules. This might allow for possibilities such as new networks of community hubs, pharmacists and other actors supporting both referral and better photo capture / diagnostics for larger volumes of people.

At this stage there is a focus on fully utilising and developing NHS infrastructure to support procured dermatology products. In this way, other pathways coming through the new national innovation model can leverage some of the common infrastructure components – making every service more sustainable and improving patient and clinical experiences where data is reusable across specialties.

If Horizon 3 is anticipated, and the underlying platform decisions at initial procurement stage allow, then these capabilities could be extended in future, separate work to supporting remote, asynchronous methods for citizens and other care professionals to access GP advice based on images and data shared through the common platform.

Recommendation

These Horizons cannot be actioned sequentially. There will be short term decisions that inform our ability to get to Horizon 3 in a cost-effective, timeous manner. The following is a recommended set of staged activities designed to balance short, medium and long term imperatives.

While the Value Case development is underway for short term procurement and implementation:

1) Map and prototype Horizon 2 & 3 services and technologies to ensure short term procurement specifications are extensible.
2) Develop an architecture outlining the necessary data standards and common platform components that dermatology product suppliers will be required to integrate with.

Once the Value Case is complete, and informed by the Horizon 2 & 3 exercises:

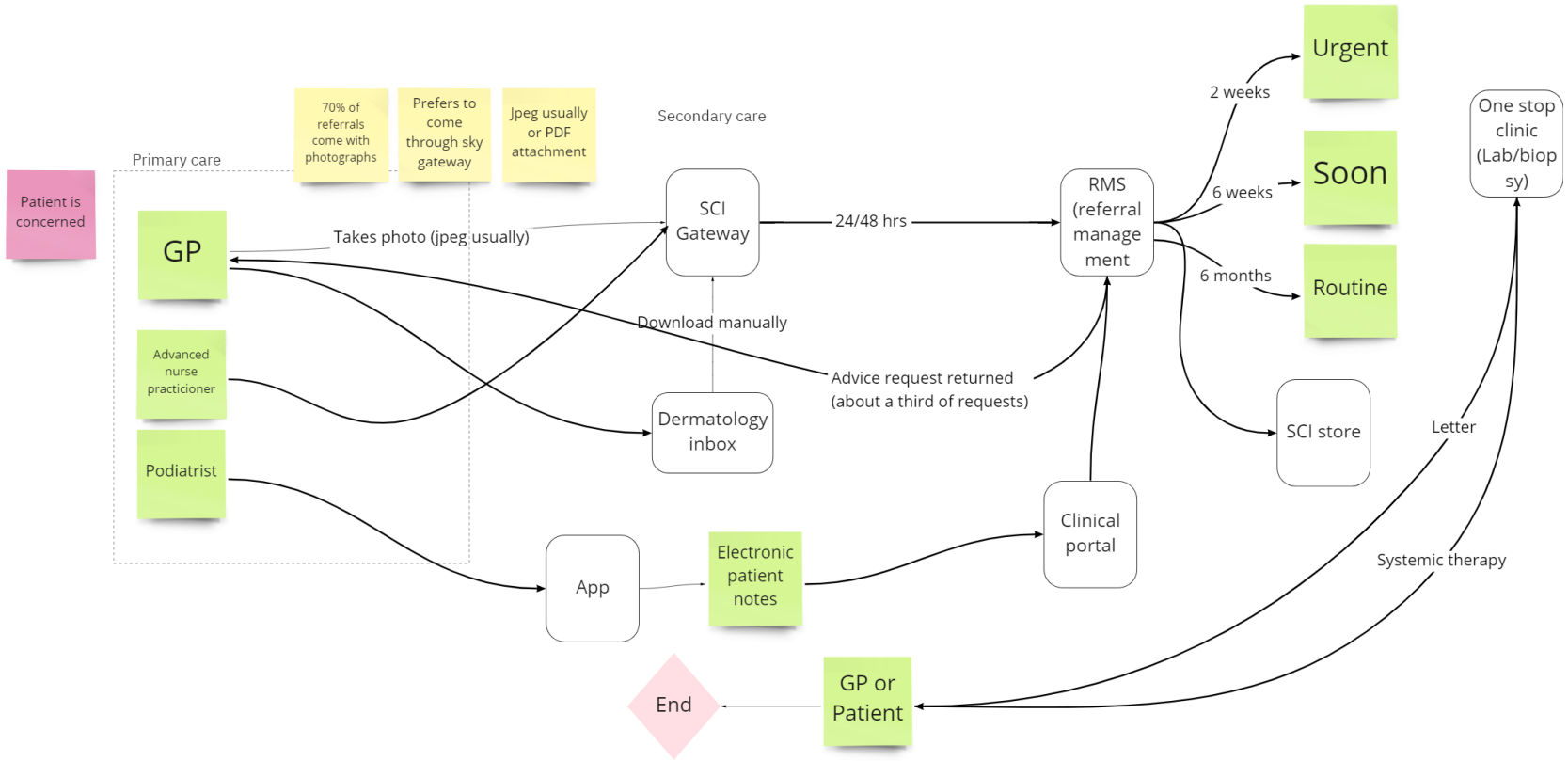
1) Develop or Procure a PCP App that can offer interfaces for primary care but architected and prepared to expand to citizens and any other professionals (including medical illustration and potential community image centres) as required.
2) Ensuring that there is an appropriate vetting interface to support triage using images and referral data side by side.
3) Develop or Procure an asynchronous digital service provider that can offer interfaces for clinics in the short term but extend out into vetting in time.

4) Procure a common, DICOM compliant data store for a short cycle (2-3 years) and feed the specification to the National Digital Platform team to inform the National Media Store build.
5) Engage with Scottish Government / digital initiatives to options appraise for the provision of underpinning identity, consent and patient-clinician data sharing infrastructure. Require dermatology product vendors (PCP App, vetting and clinic products) to federate with the identity and use the consented data sharing methods / APIs.

Later, through further development and implementation activity:

1) Allow the PCP App to read and write photo and referral information directly to the NDP National Media Store. Use storage / identity / consent management platform technologies to give role-based permissions to a range of actors in the community – allowing more flexible service models for initial photo capture / referral and resubmission of data / photos on request from secondary care.
2) Activate enhanced vetting interfaces that can access both SCI Gateway / TrakCare data and the National Media Store, and that can also manage asynchronous interactions and data sharing with the patient through an aligned approach to vetting and clinic communication.
3) Explore how the reuse of the flexible infrastructure can support image and referral data sharing from citizens and other community professionals into GP practices for the cases not requiring secondary care referral.

Appendix 2 – Example Current State Map



Appendix 3 – Preferred Future State Map (With Commentary)