Wessex Academic Health Science Network

NHS

The Dermicus Teledermatology Platform Isle of Wight Primary Care

Final Evaluation Report

Lead Authors:
Sophie Barton, Evaluation Programme Analyst

Dr Jackie Chandler, Evaluation Programme Manager

Date of Report:

February 2022

Part of The AHSN Network

EVALUATION TEAM

*Dr Jackie Chandler, Programme Manager - Insight
Sophie Barton, Programme Analyst - Insight
Ruth Barker, Programme co-ordinator - Insight
Phoebe Woodhead, Analyst and Programme co-ordinator - Insight
Rob Payne, Innovation Adoption Programme Co-ordinator - Insight and Primary Care Innovation

CORRESPONDENCE

*Dr Jackie Chandler: jackie.chandler@wessesahsn.net, Insight, Wessex Academic Health Science Network, Innovation Centre, 2 Venture Road, Southampton Science Park, SO16 7NP

DISCLAIMER

This final report presents the findings of an independent evaluation of the Dermicus Teledermatology Platform (developed by Gnosco AB). The findings of this independent evaluation are those of the authors and do not necessarily represent the views of the Dermicus team.

DECLARATION OF INTEREST STATEMENT

Wessex AHSN supports innovators to bring their innovations to the NHS as well as provide an evaluation service more broadly to our members and others. On occasion, we evaluate innovations that we have also supported. Whilst these evaluations are independent, for transparency we disclose our dual role where applicable. In this report we note the dual role of Wessex AHSN to facilitate both implementation and independent evaluation of Dermicus teledermatology.

ACKNOWLEDGEMENTS

We would like to thank Gnosco AB, Isle of Wight NHS Trust, Lighthouse Medical Limited, Isle of Wight Local Team in Hampshire, Southampton and Isle of Wight CCG and all twelve general practices for their participation in this evaluation. Other members of Wessex AHSN, Rachel Dominey, Philippa Darnton and Dr David Kryl.

DATA RETENTION STATEMENT

Our policy is to retain anonymised and pseudo-anonymised data for 6 years after the actual publication of the final report. We retain identifiable data in accordance with the Data Protection Act (DPA) and General Data Protection Regulation (GDPR) and for a period of 12 months after the actual publication of the final report. Following these retention periods, you will be given notice of imminent destruction and the opportunity to discuss any issues arising with the Project Manager concerned. Once a date has been confirmed the data will be destroyed and you will receive a certificate of destruction.

REPORT DISSEMINATION

As an independent evaluator we have a responsibility to publish a complete and unbiased account of our findings. During the process of the evaluation, we highly value input and collaboration from stakeholders with regards to the design of the evaluation and the interpretation of local data. Stakeholders will also be invited to check for factual accuracy and provide feedback on the report. However, the final report will be authored by the AHSN to uphold independence. Maintaining this independence promotes and sustains confidence in the integrity and value of our evaluations with our health system partners and beyond. Wessex AHSN are committed to supporting a learning health system and so the sharing of findings to aid spread and adoption are key to us. As a default we will make all evaluation reports available on the Wessex AHSN website.

CONTENTS

EXECUTIVE SUMMARY

Teledermatology is the recommended pathway of choice to triage dermatology patients to manage the large volume of suspicious lesion referrals from primary care to secondary care outpatient services. Wessex AHSN facilitated the implementation of a potential teledermatology solution, Dermicus Mole. The Isle of Wight (IOW) dermatology service provider, Lighthouse Medical LTD (LML), granted Gnosco AB a three-year licence for Dermicus following a local needs validation. The Covid-19 pandemic provided greater impetus for the use of teledermatology, implementation was therefore timely.

In 2018, Swedish-based company Gnosco AB approached Wessex AHSN via the Wessex AHSN and Clinical Research Network Innovation Registry with Dermicus Mole (subsequently Dermicus), a digital decision support platform which provides teledermatoscopy solutions for healthcare professionals. The system includes a mobile phone, a customised dermatoscope, Dermicus mobile application and web platform. Although, this teledermatology platform had shown improvements in skin cancer care and clinical pathways in Sweden, it was untested in the UK. Wessex AHSN conducted an initial needs validation for the IOW Clinical Commissioning Group (CCG). Dermicus became a solution supported by the Wessex AHSN primary care demonstrator programme, therefore Wessex AHSN supported both implementation and this independent evaluation.

To assess impact on patients and NHS services the key questions were whether the Dermicus teledermatology was technically and clinically fit for purpose. The multi-method real world evaluation assessed whether Dermicus teledermatology provided benefits to patients, a cost saving to services, a reduction in unnecessary referrals to secondary care and whether suitable for primary care, particularly post Covid-19. The Model of Assessment of Telemedicine 2010 (MAST, (Kidholm et al 2012)) provided a guiding framework to assess Dermicus teledermatology. Normalisation Process theory (NPT) (May and Finch 2009) via the NoMAD survey assessed implementation into GP practices.

The Covid-19 pandemic inevitably impacted on the original evaluation plan after it commenced in January 2020. This affected dermatology referrals and referral type (both urgent and non-urgent). Referrals were reduced and fluctuated, due to patients initially avoiding attendance at GP practices and subsequently returning for skin lesion assessment. As a result, it was not possible, to compare post-launch outpatient activity to a three-year baseline period as planned. Therefore, data analysis compared activity outcomes during the implementation of Dermicus with those expected in the original pathway (without teledermatology). Avoided face-to-face activity was used as a surrogate assessment for potential economic impact. Due to the extension of the evaluation phase from six months to 17 months data analysis includes more activity data and patient questionnaires than expected. This extension was due to delayed access to primary care staff for informant interviews caused by service pressures. Eventually, information was obtained from only two informants across 12 GP practices on the IOW.

The evaluation found the technical stability and usability of Dermicus teledermatology to be reliable with technical issues resolved promptly by Gnosco AB. Both primary care staff and patients found Dermicus teledermatology beneficial. It provided an easy to use and efficient system that responded swiftly to image review and triage of patients to the appropriate pathway (advice and guidance, or biopsy). LML, the dermatology service provider, negotiated with Gnosco AB the configuration of Dermicus to its local systems. Exploration in this evaluation, however, suggested subsequent issues were experienced due to the complexities of anticipating upfront integration needs into local NHS patient management systems.

The clinical functionality of Dermicus teledermatology was successful in moving GP practices from the automatic urgent two week wait face-to-face appointment to the new teledermatological pathway, from which patients were either directed to advice and guidance or straight to biopsy. This reduced the necessity for face-to-face outpatient appointments. Between January 2020 and May 2021 88% of referrals using Dermicus teledermatology were associated with avoided face-to-face appointments. Primary care staff expected teledermatology to become normal practice and found it easily adapted into their usual working patterns.

However, to ensure Dermicus teledermatology was working well in GP practices it needed further familiarity and feedback by staff on how it was embedding into their systems. Most GP practices did not express a problem with the availability and access to dermatoscopes and iPhones. One GP practice's operational solution to managing teledermatology, was to set up an Advanced Nurse Practitioner (ANP)[1] led skin clinic creating efficiencies with Dermicus equipment and GP consultation time. They also triaged patients to the clinic using eConsult and the patients' own photos initially. Other benefits of teledermatology noted were the use of images at secondary care multi-disciplinary team meetings to agree treatment plans. Also, inexperienced GPs had an opportunity to improve their diagnostic skills. One issue noted with teledermatology, not Dermicus specifically, was the lost opportunity for a consultant dermatologist to do a full body scan. However, this is balanced by the potential for increased clinical capacity by preventing those patients who do not have suspicious lesions from attending face-to-face secondary care consultations unnecessarily. Although, GP consultations took longer to enable photographing of the lesion and completion of referral details on the Dermicus platform, informants did not suggest this additional time was either overwhelming or obstructive.

KEY MESSAGES

Implementation of Dermicus teledermatology withstood the impact of the Covid-19 pandemic and was timely.

Dermicus teledermatology was easily and successfully implemented across the 12 primary care practices on the Isle of Wight.

The waiting time between referral and lesion review by consultant dermatologist dropped from a range of 10-47 days on the original pathway (standard two week wait) to less than a day via the Dermicus platform.

39 face-to-face appointments a week were avoided from a typical 62, thus increasing system capacity.

Patients were mostly positive about their experience of the Dermicus teledermatology pathway and were reassured by the quick diagnosis and follow up information.

Staff across GP practices found Dermicus worked well, although greater familiarity was required for it to become normal practice.

Initial configuration of teledermatology to meet the technical complexities of local provider patient management system requirements can raise subsequent issues not initially anticipated.

Future evaluations of teledermatology should review the benefits and cost effectiveness of different teledermatology platforms and associated

To provide an indication of economic impact of the Dermicus teledermatology pathway, it is predicted in future, that for the IOW NHS Trust there would be thirty-nine avoided face-to-face appointments per week[2] from a previous weekly total of 62, based on the 10 months when all IOW GP practices were on the teledermatology

[1] An advanced health practitioner is from a range of professional backgrounds such as nursing, pharmacy, paramedics, occupational therapy, healthcare science and midwifery have developed the skills and knowledge to allow them to take on expanded roles and scope of practice.

[2] Based on the 10 months that all practices were live with Dermicus

pathway. This represents an estimated reduction of 63% from the original pathway. In addition, the waiting time between referral and lesion review dropped from a range of 10-47 days on the original pathway (standard two

week wait) to less than a day on the new teledermatology pathway. These waiting times were sustained throughout the Covid-19 pandemic. Further economic evaluation is required to validate these estimated avoided appointment numbers.

Patients found the Dermicus pathway for skin lesion diagnosis overwhelmingly "*excellent*" and "*quick*." They felt reassured, and welcomed the ease, simplicity, and speed of diagnosis, and follow up information sent to them. Most were grateful and expressed thanks to those involved for this new service especially during the Covid-19 pandemic. A few patients would still like the option of meeting a consultant dermatologist face-to-face, irrespective of diagnosis. Healthcare professional informants indicated that they found patients receptive to the new pathway, although not all fully comprehended the virtual management of their skin lesion image.

Implementation of Dermicus teledermatology prompted suggestions for future consideration from healthcare professionals and providers interviewed. The stakeholder group (steering group) reviewed and responded to these suggestions with recommendations. Tailoring configuration to each NHS trust's patient management system and ongoing support for training to sustain teledermatology were key points. The supplier Gnosco AB will consider for future development several upgrade improvements suggested, such as making the patient consent process more efficient. Recommendations for future implementation of Dermicus teledermatology as well as future evaluation will allow for an assessment of economic costings for teledermatology versus the benefits achieved, especially avoidance of unnecessary dermatologist consultations. Clinical efficacy and safety of Dermicus were not evaluated. However, Gnosco AB complies with expected regulatory safety requirements (Health and Safety Act, 2014). More recently Dermicus became compliant with NHSX DTAC[3] requirements. For this evaluation, safety and functionality issues were logged and reported by Gnosco AB and no major concerns were raised.

In conclusion, Dermicus teledermatology is a workable teledermatology platform successfully implemented across the Isle of Wight. Local NHS trust adaptation, and working in collaboration with the developer, should support future implementation elsewhere in the NHS. As different commercial teledermatology platforms gain experience and opportunities to operate, head-to-head comparisons between platforms will evaluate their relative benefits and cost effectiveness.

RECOMMENDATIONS FOR FUTURE IMPLEMENTATION AND EVALUATION OF DERMATOLOGY

The Covid-19 pandemic heavily affected this real-world evaluation. However, it showed the successful implementation of a new digital system and pathway. It was also timely given the impact of the Covid-19 pandemic on the operation of the NHS and its outpatient services.

Future implementation of teledermatology would benefit from:

- Ensuring a continuous training programme for the primary care workforce and consultant dermatologists and advanced health practitioners in secondary care to embed teledermatology
- Informing patients about the benefits of teledermatology, whilst also ensuring they know they can opt for a face-to-face consultation
- Fuller consideration of the organisational issues for managing equipment (dermatoscopes and iPhones), along with staff training in their use

[3] The Digital Technology Assessment Criteria for health and social care (DTAC) gives staff, patients, and citizens confidence that the digital health tools used meet NHSX clinical safety, data protection, technical security, interoperability and usability and accessibility standards.

- Consideration of potential pathway and operational adaptations such as the use of eConsult and dedicated skin clinics in GP practices
- Acknowledgment of the additional benefits of teledermatology in improving diagnostic skills in primary care, enabling use of images at multi-disciplinary team meetings, and providing useful data for audit and research purposes.

Future evaluations of teledermatology should include:

- An in-depth cost effectiveness analysis based on different payment models in the NHS
- A review of different teledermatology platforms or head-to-head comparisons where appropriate.

1.0 BACKGROUND

Dermicus was selected as the teledermatology platform for the Isle of Wight (IOW) and was part of the Wessex AHSN Primary Care Demonstrator Site Programme. This demonstrator site programme provides innovators real world environments to trial and evaluate their innovations within a primary care setting, with support from the AHSN to implement and sustain their digital innovations. The programme project was supported throughout with regular stakeholder engagement via a steering group. Dermicus provided by Gnosco AB, a Swedish company, developed the platform working with the Karolinska University Teaching Hospital in Stockholm, to provide a secure and fast service for the diagnosis of skin cancer. Dermicus launched in Sweden in 2012 and CE marked in 2014, more recently become compliant with Digital Technology Assessment Criteria (DTAC) standards.

Implemented in Sweden since 2015, Dermicus teledermatology demonstrated improvements to patient satisfaction and quality of care, reducing unnecessary referrals and unnecessary surgical procedures, and improving clinical education[4]. As part of the Primary Care Demonstrator Site Programme, Wessex AHSN offers a needs validation service. This needs validation exercise appraises organisational strategic planning to allocate resources, make improvements, and determine priorities. Key stakeholders provided input on whether Dermicus teledermatology presented a solution and offered value. Following the needs validation by the AHSN and an Options Appraisal by the IOW Clinical Commissioning Group, Dermicus became the teledermatology solution of choice for the IOW NHS Trust for delivery via their dermatology services provider Lighthouse Medical Limited (LML). There was no clinical evidence in an NHS setting so Wessex AHSN agreed to support a real-world evaluation based on the outcome of the needs validation.

Deployment of Dermicus teledermatology into primary care commenced in June 2019. Five GP practices started using Dermicus in November 2019 and an evaluation commenced in January 2020. An interim evaluation report in April 2020 provided two months data on nine practices. This initially identified a significant reduction in waiting times between referral and skin lesion image review from 26 days to O.6 days by a consultant dermatologist compared with the original pathway before the introduction of Dermicus teledermatology. There was also an early indication of patient satisfaction with the new service, particularly the speed of diagnosis. This interim report also indicated that referring clinicians found adoption of the new way of working easy. This final report provides a fuller account of the real-world evaluation which was subsequently conducted throughout the Covid-19 pandemic. More referral activity data and patient questionnaires were collected due to the delays to commence planned interviews with IOW healthcare professionals.

1.1 THE CHALLENGES FOR DERMATOLOGY FOR IOW RESIDENTS

In 2019, there was an increase in referrals from Advanced Nurse Practitioners (ANP) due to pressures in primary care and a lower clinical threshold for lesion recognition, which provided the opportunity to consider teledermatology (reported by LML). Geographical isolation of the Island presents difficulties for patients because

[4] https://cancercentrum.se/stockholm-gotland/cancerdiagnoser/hud-och-melanom/projekt-teledermatoskopi/

they need to travel across the Solent for treatment on the mainland. Recruitment of speciality consultants to the Island is difficult alongside a national shortage of Dermatologists (Kings Fund, 2014). The IOW has a higher than national average of older residents who reside in one of the sunniest places in the UK[5].

1.2 PROPOSED SOLUTION

Teledermatology (remote assessment of skin lesions) on the IOW would enable the triage and referral of lesions identified as potentially malignant only going to the mainland for face-to-face outpatient dermatology review and treatment. This was expected to reduce unnecessary visits to the dermatologist and patient journeys for face-to-face appointments for those who do not, or are unlikely to, have, a malignant lesion.

Gnosco AB's Dermicus teledermatology platform aims to increase accessibility to treatment for patients with dermatological conditions, including suspected skin cancer by providing dermatologist diagnostic skills remotely (teledermatology) to primary care, when the patient first notices skin changes and goes to their GP. They provide this through a secure web platform that enables the secure upload of high-resolution images by the referring GPs for review and diagnosis by a specialist consultant dermatologist. Use of Dermicus in Sweden recorded 40,000 consultations and over 100,000 images cumulated over 6 years (reported by Gnosco AB) for all dermatological conditions at the start of the evaluation.

Standards for teledermatology exist (Primary Care Commissioning (2011) and British Association of Dermatology) with other guidance in development (A roadmap for teledermatology, NHS England and NHS Improvement [6]). Key features of these standards cover: Procedures for patient consent, information governance, staff training and competency, audit, and service quality.

1.3 CONTEXT

The IOW NHS Trust, (St Mary's Hospital) is the lead provider for the Integrated Intermediate and Specialist Dermatology services that provides level 3 dermatology[7] services for IOW residents. St Mary's Hospital and Lighthouse Medical Limited (LML) have been working together to provide dermatology services since 2008, initially under a Joint Venture Agreement and then since October 2016 with LML as the main provider under a standard NHS subcontract. LML has separate IT and information governance contracts with IOW NHS Trust to enable service delivery. The IOW NHS Trust and HSIOW CCG – IOW Local Team[8] fully support LML to provide an integrated dermatology service. Gnosco AB is currently under contract with LML for three years from April 2019 with a permissible option to extend. LML provides first line support to GP practices and is responsible for the Dermicus platform training, and provision of the iPhones and dermatascopes to primary care. Gnosco provides training to LML. A project Steering Group provided oversight and was the key reporting mechanism between Gnosco AB, LML, IOW NHS Trust and CCG, Wessex AHSN project team and the independent Insight evaluation team.

Fig. 1 shows the original dermatology pathway and the anticipated new pathway following the implementation of Dermicus teledermatology at commencement of the evaluation.

[5] https://digital.nhs.uk/data-and-information/publications/statistical/patients-registered-at-a-gp-practice
[6] The roadmap is available on The Elective Care Community of Practice Dermatology workspace on the Futures NHS Collaboration Platform
[7] The British Association of Dermatologists define the service as level 3 Intermediate Specialist Services (community) and level 3 Specialist Care (secondary care) – see BAD service level of care document
[8] On 1 April 2021, the Isle of Wight CCG, along with partner CCGs in the region merged to form Hampshire, Southampton, and Isle of Wight Clinical Commissioning Group (HSIOW CCG).

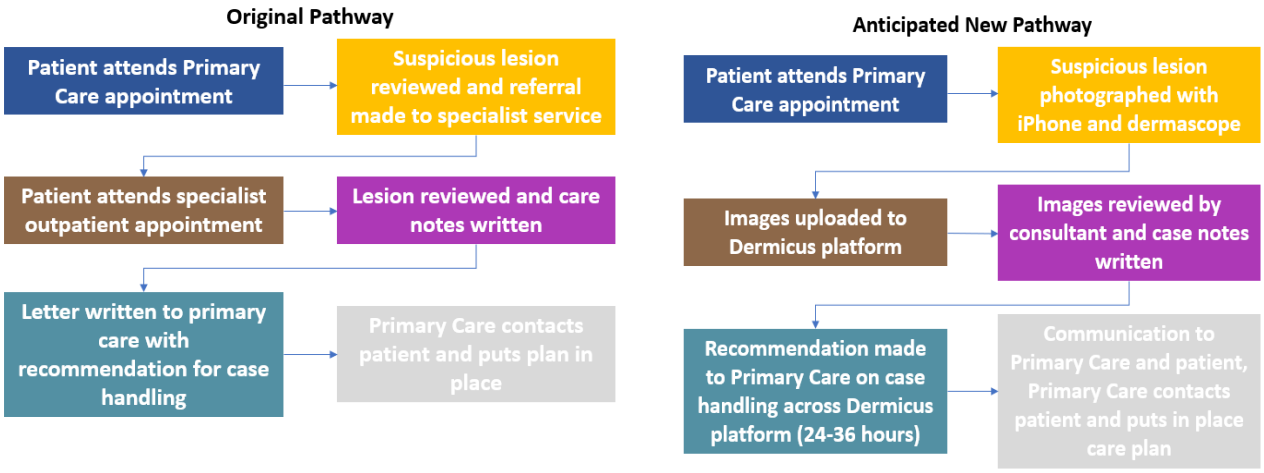

Fig.1. Original and anticipated new dermatology pathway

An interim report (April 2020) reported on the initial evaluation phase between January and March 2020. The Covid-19 pandemic and lockdown created a pause in data collection in the second phase of the evaluation. This second phase planned to interview GP practice staff and consultant dermatologists. Activity data and patient questionnaires continued throughout this extended pause providing a longer follow up period than planned. Interviews were delayed until 1 June 2021 due to ongoing pressures within primary care.

1.4 CONCEPTUAL FRAMEWORKS

An assessment of evaluation findings of this real-world validation applied an innovation focussed framework, the MAST framework (Model of Assessment of Telemedicine (2010), the European Commission's recommended tool for assessing and making decisions about telemedicine applications (Kidholm et al 2021), (Appendix 1).

Normalisation Process Theory (NPT) (May and Finch 2009) provides a validated instrument (NoMAD) to understand how innovations in healthcare are implemented in practice, and how new ways of working become embedded and sustained. Based on Action Theory, it is concerned with explaining what people do, rather than how they describe their attitudes or beliefs. The focus is on factors (beliefs and behaviours) that promote or inhibit (enablers and barriers) the implementation of an innovation.

2.0 EVALUATION AIMS AND OBJECTIVES

The evaluation aims and objectives were developed during this work and updated to account for the Covid-19 pandemic and its impact on the project.

The aim was to conduct a real-world evaluation of a teledermatology solution across primary care within the IOW NHS Trust and CCG to improve patient experience of dermatology screening and reduce costs of skin cancer screening to the CCG.

In addition, review the utility of the teledermatology solution considering the changing environment with the Covid-19 pandemic national emergency. Objectives were:

- To understand the suitability of the Dermicus tool within a primary care setting
- To determine if there is a cost saving compared to the present screening (original pathway)
- To reduce unnecessary referrals to secondary care
- Additional aim was incorporated in October 2020 to assess the future potential of the teledermatological solution as part of the post COVID-19 new normal.

2.1 EVALUATION QUESTIONS

The primary goal of the evaluation was to validate the effectiveness of the Dermicus teledermatology platform and gain insight around implementation. Therefore, this real-world evaluation focused on the following evaluation questions:

Is Dermicus technically fit for purpose?
Defined as its stability, useability, and interoperability with NHS systems.

Is Dermicus clinically fit for purpose?
Defined by the experience of clinicians, impact on clinical activity and reduction on inappropriate referrals.

What is the impact on patients?
Defined by the experience of patients receiving Dermicus teledermatology.

What is Dermicus' economic impact on NHS services?
Defined by modelling of the impact of pathway changes but not of the associated costs. This is due to changes in the usual NHS funding arrangements and disruption to outpatient activity caused by the Covid-19 pandemic.

3.0 EVALUATION METHODS

The following describes the original evaluation plan; and how Covid-19 has inevitably impacted on this evaluation, changes, and limitations.

3.1 EVALUATION DESIGN

Initially, a rapid cycle formative evaluation using a multi-method approach, proposed review points at 3 and 6 months. The MAST framework (Kidholm et al 2021) recommends the use of a comparator in an evaluation, such as GP practices not using teledermatology. However, all IOW GP practices were expected to participate, and all non-urgent referrals sent across the Dermicus platform. Therefore, the original design proposed previous baseline outpatient (OP) referral data as the comparator. However, COVID-19 resulted in changes to the evaluation design.

3.1.1 CHANGES TO EVALUATION DESIGN DUE TO COVID-19 PANDEMIC

In order to assess the clinical effectiveness of Dermicus, the evaluation team planned to look for changes in the volume and casemix of referrals and for changes in waiting times compared to a three year baseline period, prior to the launch of Dermicus. However, national guidance was released in March 2020[9] in response to the Covid-19 outbreak, urging NHS providers in England to free up hospital capacity by postponing non-urgent elective treatment.

For the Dermatology service at the IOW NHS Trust this resulted in both fewer referrals overall (17% fewer for the 12 months between March 2020 - February 2021 compared to the previous 12 months) and changes to the referral type (two week wait, routine and urgent appointments) and pattern of activity (patients avoiding GP attendance fluctuating with a subsequent rise in attendance as confidence returned). A sharp drop-in total dermatology activity between March and April 2020 preceded a busier than usual summer as patients began to return to primary care. Where referrals for suspected cancer had typically made up 26% of all dermatology activity prior to lockdown, they accounted for 54% of referrals in April 2020.

[9] https://www.england.nhs.uk/coronavirus/wp-content/uploads/sites/52/2020/03/urgent-next-steps-on-nhs-response-to-covid-19-letter-simon-stevens.pdf

As a result of these changes in attending behaviour in both primary and secondary care, it was no longer valid to compare post-launch outpatient activity to a pre-launch baseline period. Instead activity data analysed focussed on the period following the launch of Dermicus (January 2020) and compared outcomes under the Dermicus pathway to outcomes expected under the original pathway. Analysis of waiting times over the same period compared Dermicus referrals to other referral types not received via the platform.

This approach would allow the evaluation team to explore how Dermicus operated under the challenges of the Covid-19 pandemic while avoiding the issue of comparing baseline data to post-pandemic data that did not reflect typical outpatient activity. It was not possible to undertake a full economic assessment as part of this evaluation due to the block contract arrangement between Lighthouse Medical and the IOW Trust. Therefore, avoided face-to-face activity brought about by Dermicus was a surrogate measure.

3.2 EVALUATION DATA COLLECTION

The table at Appendix 2 details data collection by evaluation question with planned against actual data collected. The multi-method approach undertaken included a 23-question validated questionnaire (NoMAD survey) based on Normalisation Process Theory (May et al 2009). This assesses implementation processes from the perspective of professionals directly involved in the work of implementing complex interventions in healthcare. Other data was obtained from NHS Trust outpatient activity and referral data, patient post consultation feedback questionnaires, patient case studies completed by primary care staff and interviews with primary care staff and dermatologist, as well as an 'issues log,' supplied by Gnosco AB, which recorded any technical issues that arose with use of the Dermicus platform. The informant interviews provided considerations for future implementation of the Dermicus teledermatology platform. The stakeholder (steering) group formally reflected and responded to those considerations as part of this report. The original data collection phase of six months from January 2020 to June 2020 was extended by 11 months to 31 May 2021 because of the Covid-19 pandemic.

4.0 FINDINGS

The extraordinary event of the Covid-19 pandemic inevitably impacted data collection and the findings. Therefore, this event impacts the interpretation of findings. This section presents findings by evaluation question, and the experience of Dermicus by patients and staff using the platform, its impact on referrals to secondary care and highlights issues raised for consideration for future roll out of Dermicus and other teledermatology platforms to other NHS trusts and other providers.

4.1 DATA COLLECTED

Lighthouse Medical Limited (LML) provided Dermicus platform data by a count of lesions, rather than by individual patients. A patient can have multiple lesions; however, they may have one appointment to review them all, rather than individual appointments. Data collection started in January 2020 and aggregated by month and outcome of referral. IOW NHS Trust provided referral and outpatient data from April 2016; however, this data was not used as explained previously, due to the Covid-19 pandemic. This was a count of referral activity, not individual skin lesions (unlike Dermicus platform data).

To provide indicative economic analysis, an estimate of avoided face-to-face appointments was undertaken, however, both payment arrangements and number of referrals seen were affected by the Covid-19 pandemic, which needs to be accounted for when interpreting impact. Due to the Covid-19 pandemic, IOW NHS Trust was only able to provide a count of referrals by month, rather than proxy measures for skin lesion-related activity. It was not possible to obtain outpatient data, and so analysis includes only referrals by month for teledermatology.

It was also not possible to compare present and historical trends, so analysis uses activity data from January 2020 onwards.

Due to the complexity of the Covid-19 pandemic effect on services, invitation to interview was widened to all twelve practices, from the original plan, to provide at least one staff member for interview. Five interviews eventually completed. Those interviewed provided personal and unique perspectives and were two GPs (one with cancer dermatology expertise), a clinical nurse specialist working within the specialist dermatology service and the dermatology consultant employed by LML. The fifth interview was, undertaken with the LML manager overseeing the process between primary care and reviewing dermatologists. Interviews with key informants followed ethical practice and gained informed consent. However, with this evaluation key informants are easily identifiable given the unique context. Key informants received a final draft of this report and have all provided their consent for its publication.

4.2 PATIENTS' EXPERIENCE OF DERMICUS

Patient experience was gathered by 1) a short questionnaire following a Dermicus appointment at the GP practice and on receipt of diagnosis and 2) short case studies provided by primary care staff. Continuous collection of the former questionnaires was extended due to the Covid-19 pandemic, thus collecting a greater number than originally anticipated. Unfortunately, only one GP practice was able to respond to the request for case studies and so provides limited information.

A few questionnaires (N=19) were returned from a total of 99 patients referred on to the new pathway between January and end of February 2020, the initial roll out phase. This data provided an early indication that most patients valued the speed at which they were able to receive diagnosis and follow up information or an appointment when needed.

Referrals to Dermicus between 1 March 2020 and 31 May 2021 resulted in 399 completed questionnaires. Although, a low response rate (13.5%) from a total number of referrals (N=2,963). It is not possible to determine whether there is any response bias related to patients who did not respond. Although, the strength of the findings suggests a greater number of respondents would not necessarily impact the results. A speculative assumption is that dissatisfaction might result in taking the opportunity to complete the questionnaire. Most respondents were aged over 65 (N=246) and 116 were aged between 46 and 65 years. Twenty-nine were under 45 years (7%). For 235 patients this was not their first time contacting the GP with a suspect skin lesion and, of those, 191 had visited the GP between 1-4 times with skin concerns. 71 patients had received previous treatment for a cancerous lesion.

On attending the GP appointment, 377 (95%) were satisfied with the information and explanation of the new pathway provided. Most of those that were not satisfied wanted more information. Most were happy with the procedure (N=361, 92%), with 37 patients wanting to see the dermatologist face-to-face. A comparison between those for whom this was their first time, and those who had previously had skin lesion examination, found minor difference between the two groups on levels of satisfaction with information and happiness with procedure and satisfaction with the explanation given to them by the doctor. Both groups reported high levels of satisfaction (95% and 96%). There was however a slight difference between the two groups in terms of whether they were happy about having their skin change photographed. Those who had received dermatologist treatment for skin cancer in the past were less happy than those who had not (85% vs 92%) but overall, the results for both groups were still positive. 345 patients were happy with getting a quick diagnosis and 240 were happy not to travel to the dermatologist appointment. Overall, patient respondents were happy with the new pathway, and many submitted comments allowing a more nuanced understanding of their experience and views.

4.2.1 QUESTIONNAIRE FREE TEXT COMMENTS

Of the 399 questionnaires received, nearly half the patients (46% [182]) had completed the optional free text comments, a strong response. Patients following the Dermicus pathway for skin lesion diagnosis overwhelmingly found the service they received was '*excellent*' and '*quick*.' They felt reassured, and welcomed the ease, simplicity, and speed of diagnosis, and follow up information sent to them. Most were grateful and thanked those involved for this new service. Several comments explained why the patient would prefer to see a dermatologist, for example, they lacked confidence with technology and wanted to know that this pathway was safe. Some patients preferred face-to-face consultation regardless because concerns remained following diagnosis, and there was a preference for physical examination or patients had outstanding questions. Some comments indicated that follow up after Dermicus referral required greater clarity as to what was next regarding their treatment. Some patients would welcome a copy of the photo to monitor future changes for comparison. Finally, several respondents raised the point that teledermatology was a benefit during the Covid-19 pandemic as they would not have to travel unnecessarily.

One practice completed case studies and so not representative of all practices. The case studies asked about patient presentation to the practice, their response to Dermicus and the photo procedure and the outcome of the consultation e.g., referral for treatment. As examples, they illustrate the following:

A 64-year-old woman who delayed presentation to practice due to Covid-19 lockdown and was anxious about a suspected (by primary care practitioner) nodular melanoma on the right upper arm which needed both a referral to a multi-disciplinary team and biopsy of the lymph node. The patient was happy to go through Dermicus initially.

An 82-year-old man who presented with a large, neglected lesion on his lip "it's a wonder he could talk and eat as it was very crusty and looked sore. He had been ignoring it" and was not anxious but happy not to go to a clinic appointment for examination. Diagnosed with fibroxanthoma which was excised and required no further treatment.

A 68-year-old woman presented with a bleeding mole and anxiety so was happy to proceed with Dermicus and get a quick diagnosis. Basal cell carcinoma confirmed and treated.

A 43-year-old woman "not overly anxious" but bra strap was irritating a lesion. She understood she would get a quicker diagnosis rather than wait to be seen at a clinic. Lesion removed and sent to histology within a week of presentation and melanoma diagnosed.

This single practice sample provides illustrative cases that indicate patients often present late for a variety of reasons, but diagnosis and treatment is swift as shown by the data presented in section 5.2.

All interview informants supported the general view that patients were positive about having their lesions photographed and reviewed by a dermatologist. GPs did not experience patients refusing a mole photograph.

> *"Not once [did anyone decline Dermicus]" [GP Lead], stating: "I was expecting people to say, "oh are you sure it is ok to just see the picture? can I see the person face-to-face", but, actually, I don't think it's ever happened that I know of"* [GP Lead]

> *"I haven't had any patients who question it or are concerned"* [GP]

The explanation was it did not prevent a face-to-face consultation with the dermatologist in the instances when required.

> *"It doesn't stop them seeing someone, it's sort of a prelim"* [GP Lead]

From these interviews there were several considerations for implementation to enhance the patient experience of the teledermatology pathway (see section 5.8).

4.3. TECHNICAL STABILITY AND USABILITY OF DERMICUS

Issue logs, interviews and additional information supplied by Gnosco AB address this question.

Monthly steering group meetings discussed all reported technical updates, issues, and improvement suggestions. Gnosco AB report they have addressed several improvement suggestions during the implementation and roll out of Dermicus resulting in additional features to improve the experience and usability of the platform.

The interim report (April 2020) found two issues of note that impacted on patient safety. First, LML did not receive three referrals entered onto Dermicus by one GP Practice. A root cause analysis conducted by Gnosco AB established this was an administrative oversight in the process of setting up new practices on the system. The introduction of a two-way check sought to mitigate this issue. Second, the reviewing dermatologist did not receive information regarding two patients with a family history of skin cancer. Gnosco AB discovered a bug that caused the family history of skin cancer not to appear to the reviewing dermatologist. The problem was resolved immediately after discovery. Gnosco AB initiated a risk analysis of this issue together with LML. The dermatologist confirmed their family history was not relevant to their diagnosis or treatment, in these instances. No further instances reported, suggesting early teething problems.

Since the interim report, there have been no similar incidents or any other serious issues that impact patient safety as reported by the Gnosco AB issues log. However, the safety of Dermicus was not separately evaluated. Reported issues were minor in nature, for example, photo upload failure which occurred at a handful of practices, a single instance of a GP closing a referral in Dermicus when they should not have had the option to do so and two instances where all Dermicus platform users lost access to the system for a brief time. Gnosco AB quickly resolved all issues.

The general manager for LML reported few issues had occurred in recent months with most resolved during the early roll-out phase. Gnosco AB now provides a support line for LML to submit any issues for attention. Recently, it transpired LML cannot access the platform to add clinicians to review all cases across all practices. This means it is possible to add a user for a single practice but not a user to have the ability to access all practices (to enable audits to take place or a get a second opinion). Therefore, LML still need to contact Gnosco AB to arrange full access to these clinicians. There are plans to mitigate this in a planned update.

Overall, the five informants were positive about the usability of the Dermicus platform, reporting effective and appropriate use by referring clinicians. Several technical issues were reported via the Steering Group and were subsequently resolved by Gnosco during the bedding down implementation phase (e.g., difficulty obtaining logins, problems with Wi-Fi connectivity, inability to rotate images (possible with training offered by Gnosco), and premature closure of referrals. A subsequent platform update resolved the following issue by enabling a feature for the selected user to close the case.

> *"When the admin clicks on that [closed case button], it shuts it [the referral] down which means we've completed it in our pathway. Somebody going into it from an external saw close case, oh, that obviously means just close the window now […] but actually, what it was doing was shutting them down, so we had to get them [Gnosco AB] to unlock them, and go, "Can you please either restrict that or change the wording because it's really misleading"."* [Lighthouse Manager]

Overall, all informants reported multiple benefits with the Dermicus platform, which included the speed of reviews by dermatologists, ease of use of the Dermicus teledermatology equipment and platform, and the ability to use the dermatoscope beyond primary care in secondary care.

> *"You'd send a referral, and likely as not you'll get within a day or two you've got an opinion or a plan"* [GP Lead]

> *"If you can use a smartphone, you can use this"* [GP]

> *"We use it in different ways actually from a clinic setting, [… and] take a photograph of a patient in the ward,"* [Dermatology-Clinical Nurse Specialist]

Another important benefit, for GPs, was the capacity to triage patients using eConsult (GP consultation and triage online platform) especially during the Covid-19 pandemic. One practice, as an example, set up a skin clinic that allowed referral either by GP or patient images sent through eConsult. This does require the patient to take their own photograph using their mobile phone. An ANP or a similarly qualified non-medical healthcare professional would run the skin clinic. This does raise an issue that warrants future evaluation on the use of eConsult for this purpose (Janda et al 2020).

> *"If it looks horrible and nasty on eConsult, you already know that you're going to be using a* Dermicus [dermatoscope]*"* [GP]

Along with these benefits, informants provided several considerations for wider implementation to further enhance the users experience of the platform (See section 5.8).

4.4 TECHNICAL INTEROPERABILITY OF DERMICUS

Interviews and additional information provided by Gnosco address this question.

LML and the IOW Trust specified the initial Dermicus configuration to a pre-defined pathway, compliant with the local NHS and British Association of Dermatology requirements (reported by Gnosco AB). This solution at the time, enabled the secure export of a PDF report that attached to LML's own patient record system. The updating of other patient management systems at LML involved an administrator. Other national systems that have integrated Dermicus would not require this PDF export and updating of other local patient management systems Dermicus. These national systems are the Patient Demographic Service (PDS – the NHS Spine), Electronic Referral (e-RS) and TPP(SystmOne). LML's planned implementation of TTP SystmOne did not occur due to a review of IOW systems across their ICS. Therefore, the original solution of exporting the referral as a PDF from Dermicus, and the need for an administrator to update other systems, has remained. LML managed users of the Dermicus platform independently of Gnosco. There was, however, frustration with reporting outputs.

> "*I would like to see a better output. Probably my largest gripe about it is its inability to output good information*" [Lighthouse Manager]

All informants reported the lack of interoperability of the Dermicus platform with existing, electronic records and local patient management systems as the most significant limiting factor of Dermicus.

> *"The only things which could perhaps be better are, one, it doesn't really link superbly into our GP practice systems" [GP Lead]*

However, there is an ambivalence to full integration as it provides a degree of adaptability and flexibility.

"The absence of integration is a good thing because you're not tied to anything so you can use it however you want to" [Lighthouse Manager]

However, other examples suggest the option to have easy access to the images for future review and comparison would be an advantage.

"To just upload them onto our medical records for reference, so when I put them back in to review in two months or three months, whenever it is, to see if the lesion's changed at all" [Dermatology nurse]

"No record of these photos, and I've got no evidence that I've confirmed that patient's consent and so forth. I've got nothing like that on the system [not the Dermicus platform but GP patient record system]*" [GP]*

Implementation of Dermicus over time has involved several updates and there are inevitably complex processes to embedding external remote care systems into NHS IT systems. Interviews undertaken at the end of evaluation in June 2021, suggests a desire for full integration, although with some ambivalence due to loss of local system flexibility.

4.5 CLINICAL FUNCTIONALITY OF DERMICUS

The Dermicus platform and Trust activity data, NoMAD survey and interviews address this question.

Between January 2020 and May 2021, when the Dermicus platform went live, 2,963 referrals for skin lesions were received at the IOW NHS Trust. Fig.2 provides referral data marking key relevant Covid-19 pandemic events.

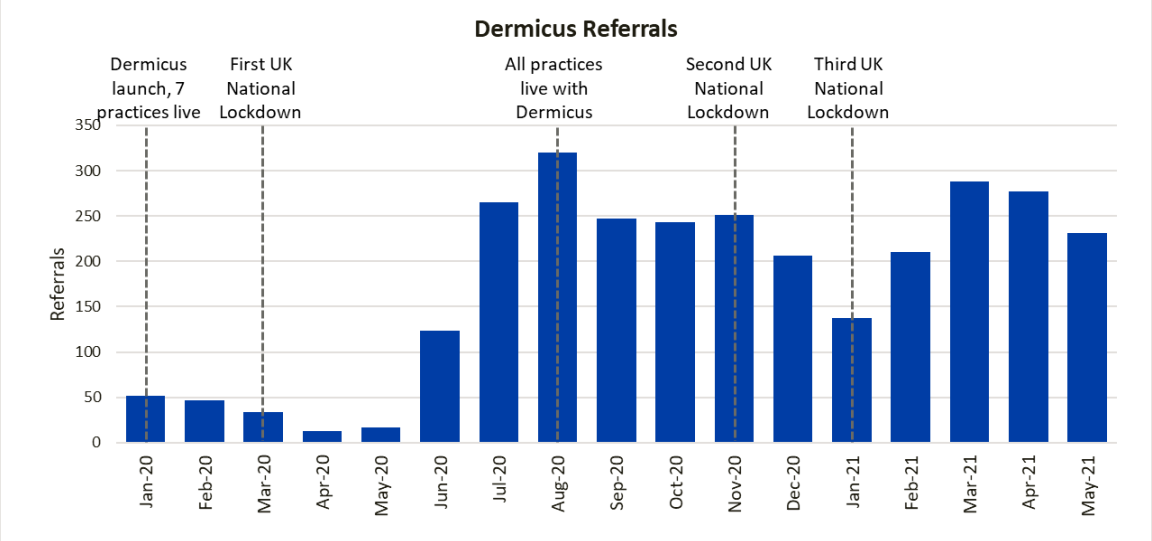

Fig. 2. Referrals received via the Dermicus platform

Under the original pathway, all patients referred by their GP attended a face-to-face review appointment with a dermatologist at the hospital. Under the IOW teledermatology pathway, referrals were graded as 'advice and guidance' or 'straight to biopsy' where appropriate, meaning that the initial face-to-face review appointment is avoided in these cases. Additionally, referrals with an outcome of 'Rejected' or 'Referred out' may also represent an avoided appointment since teledermatology provides an opportunity to redirect them before they result in an attended appointment.

Of the 2,963 referrals received via the Dermicus platform to 31 May 2021, 50% had an advice and guidance outcome, 37% had a Biopsy outcome and 1% were 'Rejected' or 'Referred out' meaning that in total 88% of Dermicus referrals were associated with avoided face-to-face activity. This high proportion indicates that the

use of Dermicus had a significant impact on reducing face-to-face appointments. Table 1 and Fig.3 provide a breakdown of referral outcomes.

Dermicus referral outcomes Jan 20 - May 21	No. of referrals
Advice & Guidance	1,473
Biopsy	1,032
Review	415
Rejected/Referred Out	13
Unrecorded*	30
Total	**2,963**

***As reported in data received (assumed blank or missing)**

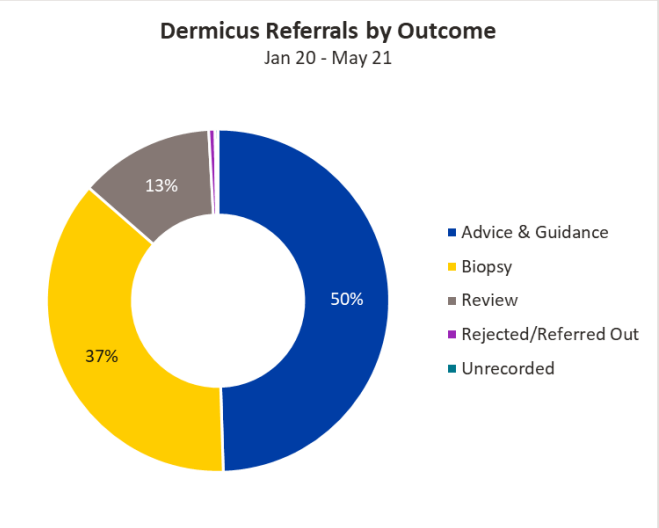

Table 1. and Fig.3. Dermicus referral outcomes

4.5.1 NOMAD SURVEY DATA

Primary care staff completed the NoMAD survey about the implementation of Dermicus within their practice. The findings provided an important overview of implementation activity. Four core constructs make up the NoMAD survey defined as:

i. Coherence: the mobilisation of a new practice – how it is conceptualised and held together in action,

ii. Cognitive participation: participation in a new practice – how members decide to engage,

iii. Collective action: enacting a practice – how the new work is organised, and activities structured and constrained, and

iv. Reflexive monitoring: the appraisal of a practice – how the new practice is appraised and the effects of appraisal, i.e., how it is 'understood' and what changes the team make to accommodate the new practice.

The NoMAD instrument measures the presence of these four constructs to assess staff ability to mobilise, organise and engage in changing practice as well as appraise and reflect on changes made with the ambition to embed change as a routine practice. It comprises 20 statements across the four components and is rated on an agreement scale between 0-5. Three additional questions rated on an agreement scale of 0-10 are general to the context of the implementation. The NoMAD instrument questions are tailored to the specific project, a copy of this project's survey is available at Appendix 3.

The original plan was to survey primary care staff and dermatologists at commencement of the evaluation and towards the end of the evaluation at months two and four. Subsequently, the second survey was significantly delayed due to the Covid-19 pandemic.

34 members of staff completed the NoMAD survey; seven surveys collected in February 2020 from primary care staff only were reported in the interim report. Nine practices were engaged at that time. Overall, views of these seven pre pandemic surveys suggested primary care staff did not find the Dermicus teledermatology pathway overly complex but easily adaptable into their normal working patterns.

27 surveys were completed in June 2021. The following analysis combines all respondee surveys. For those staff completing the survey 88% were involved in delivering Dermicus to patients. Responses were received from all 12 IOW GP practices, as well as LML Clinic, a locum GP, and members of NHS IOW Trust. Two respondees reported being in their organisation for less than a year with 29% being there for three to five years, and 26% for six to 10 years. The majority of respondees were GPs (65%), other respondees were nurses and advanced nurse practitioners, as well as a consultant dermatologist and a GP with expertise in skin cancer.

Fig. 4 shows the combined scores for the three general questions from the NoMAD survey on how they view Dermicus as part of their work. The combined scores across all practices indicate a high expectation (score above nine) that Dermicus would become part of routine care in the future. Relative to this score, a slightly lower score suggests staff felt less sure Dermicus was currently part of their normal work, and they were less familiar with Dermicus. However, overall scores were high above eight showing that the platform is not overly complex and is easily adapted into normal working patterns in primary care.

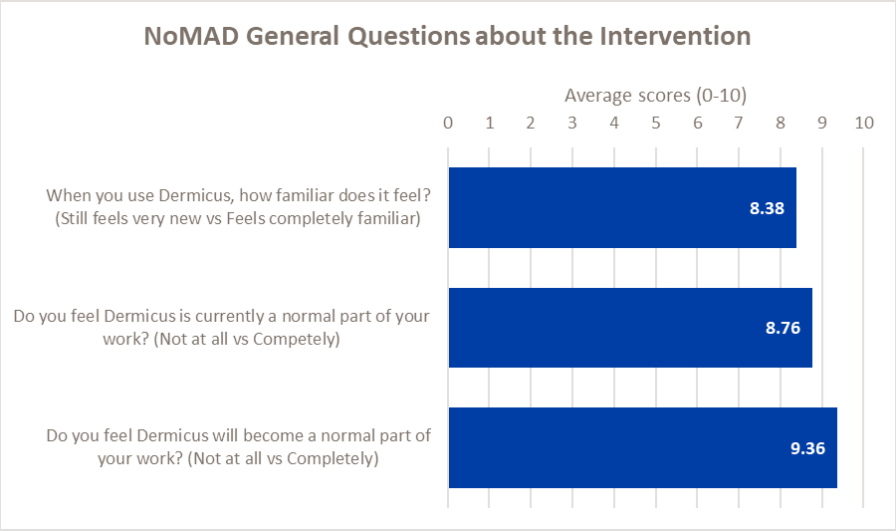

Fig.4. NoMAD scores for general questions across all surveys

Fig. 5 below shows the combined score for each of the four constructs with small differences between the constructs, however, all scores were above four (scale 0-5) which suggests high agreement across all GP practices.

Cognitive engagement and Coherence generally scored relatively higher than Collective action and Reflexive monitoring constructs. This suggests staff had a fair idea of 'what Dermicus was and was for' (Coherence) and 'who they needed to involve to use it' (Cognitive engagement), but they had less confidence about 'how to integrate Dermicus into their context' (Collective action) and 'limited feedback or monitoring mechanisms to know if Dermicus was working' (Reflexive monitoring). However, the differences between scores is small and the sample relatively small, although responses are representative of all GP practices on the IOW.

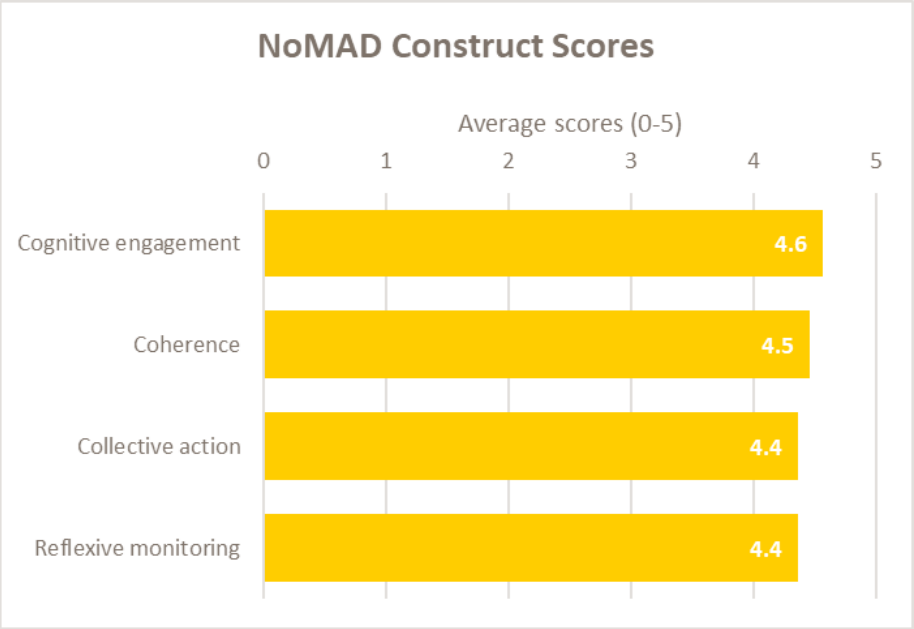

Fig.5. NoMAD scores across constructs for all surveys

A single dermatology specialist reviewed images on the Dermicus platform on behalf of LML. He completed the NoMAD survey. He had been in his role for between 3-5 years previously conducting face to face reviews. For the general questions about Dermicus teledermatology, his scores were 10 for all three questions. For the construct scores, again he scored highly with an average of five across Cognitive Engagement, Coherence and Collective action, and 4.2 for Reflexive Monitoring. Overall, this consultant scored higher than the average scores across all GP practices. This is unique feedback because this was the only reviewing dematology consultant of the images. This consultant was also interviewed.

Two respondents from the June 2021 NoMAD survey reported sometimes having to wait for a dermatoscope to become available. Four people reported this rarely occurred, and the remaining 21 never experienced waiting for a dermatoscope. Processes are in place to procure equipment via LML. Internal processes in GP practices suggest there is not a major issue currently with access to equipment.

4.5.2 CHANGES TO PATHWAY DESIGN

All interviews report favourably the ability of the Dermicus platform to streamline care, and its flexible clinical functionality. Use of the Dermicus platform differed across sites to ensure its fit within local dermatology and primary care practice pathways as indicated by the NoMAD survey results. One informant (GP lead) reported one practice arranged specific skin clinics to support delivery of Dermicus teledermatology led by a trained ANP. This provided an example of an operational change in response to introducing teledermatology. This allowed the iPhone and dermatoscope equipment storage and use in a single place within the practice. It also created efficiencies in diverting patients with suspicious skin lesions from extended GP consultations. This adaptation was possible as the Dermicus platform was simple and easy to use and did not require the person referring to be medically trained professional.

> *"You don't need to be seen by a doctor. A nurse practitioner can do just as well as a doctor"* [Dermatology Consultant]

Fig. 6 shows the adaption of the clinical pathway from the anticipated new pathway at the beginning of the evaluation.

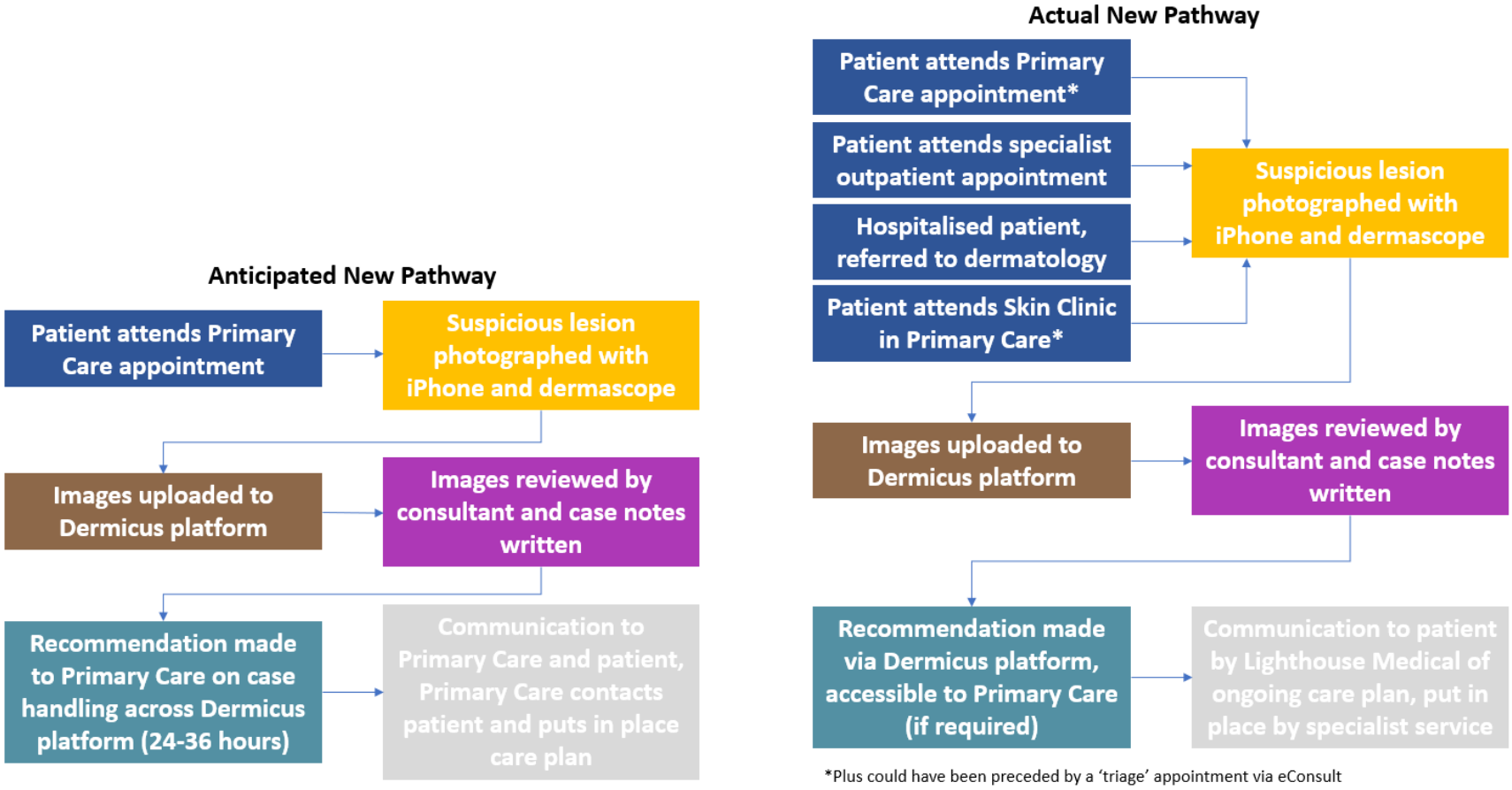

Fig. 6. Anticipated and actual dermatology pathway

Also reported was the use of the Dermicus platform to share images of skin lesions at multi-disciplinary team meetings to determine the course of treatment required.

GP informants (N=2) suggest an increase in confidence in managing patients with suspicious skin lesions by having a quick diagnostic pathway without waiting for an outpatient appointment and making the decision to refer patients onto the original two week wait pathway. One informant felt inexperienced GPs benefitted and were more likely to use the platform to refer and ensure a dermatologist was making a diagnosis as opposed to making their own diagnosis.

> *"I […] use it more than my more experienced colleagues"* [GP]

A potential problem identified precluded the opportunity to conduct a full body scan for other potential suspicious lesions on the patient by the dermatologist.

> *"If I were to think of a hole in the system, i.e. where things might go wrong, one of the things you could say is that if you only look at that mole that you've got sent, there might be a mole sitting next door, which the GP hadn't realised that the patient hadn't realised was the one they really should have sent" [Dermatology consultant]*

Nevertheless, there are important benefits to conduct an initial triage to manage the volume of patients and increase the clinical capacity of the service.

> *"Without it [teledermatology], all those patients would have to come to see face-to-face consultant dermatologist, but he doesn't have to do that. He sees them [the lesion] remotely. He says what he wants us to do. I get them in, we get to see that. Then we see a lot more patients because of it. We're able to get a lot more people through the clinic each week"* [Dermatology- Clinical Nurse Specialist]

There was inevitably an impact on the length of time GPs spent with patients because to conduct a comprehensive assessment to take photographs during the consultation rather than perform a referral on a visual inspection of the lesion required more time.

> *"Mole reviews, we normally say are five-minute consultations because it's literally just, "Show your arm. Right, good or bad?" That's it. Actually, the process is a little bit longer [now]"* [GP]

Overall, the interviews suggested the Dermicus platform was adaptable and easy to use. All those interviewed suggest positive aspects of the clinical functionality offset problems with the administration required for the platform. Section 5.8 and Appendix 4 provide considerations raised by interview informants on implementation to improve the clinical functionality of the platform.

4.6 ECONOMIC IMPACT

Initial economic modelling was undertaken to assess potential avoided costs using tariff information supplied by the Trust and the published non-mandatory price for a non-face-to-face consultant led dermatology appointment. However due to the complexities provoked by the Covid-19 pandemic it was not possible to establish these cost components. In addition the block contract arrangment between LML and Gnosco limited breakdown of costs. The findings are based on avoided appointments which could provide an estimate of costs based on local cost data and assumptions.

When a GP makes a referral via the Dermicus platform, they submit a separate referral for every skin lesion they photograph. It is common for patients to have several lesions photographed at the same appointment. However, if a reviewing consultant decides that a face-to-face appointment is necessary, the patient would be assessed

for all lesions at the same time and not offered a separate appointment for each lesion. In order to accurately assess how many appointments were avoided by Dermicus a percentage decrease was applied to get the *likely* number of secondary care referrals 'Dermicus' referrals would have resulted in.

Between August 2020 – May 2021 (the period where all practices were live with the platform), the number of teledermatology referrals actually received by the IOW Trust ranged between 15% and 19% lower than the number of referrals coming through the Dermicus platform, averaging at 17% lower. A 17% decrease was therefore applied to all outcomes of the 2,963 referrals received via the Dermicus platform, resulting in an estimate of 2,459 referrals to the IOW Trust in total.

Table 2 below shows the assumptions made based on pathway changes resulting from the use of Dermicus teledermatology.

Table 2. Assumptions based on pathway changes

Assumptions
1. Dermicus teledermatology referrals that have an outcome of 'Advice & guidance' would have resulted in a face-to-face review appointment under the original pathway
2. Dermicus teledermatology referrals that have an outcome of 'Biopsy' would have resulted in first a face-to-face review appointment followed by a second separate appointment for a biopsy under the original pathway. Rather than the Dermicus pathway that went straight to biopsy.
3. Dermicus teledermatology referrals that have an outcome of 'Rejected' or 'Referred out' would have resulted in a face-to-face appointment under the original pathway

These assumptions applied to the 2,459 referrals received by the Trust via the Dermicus platform and resulted in an estimate of 2,090 avoided face-to-face appointments over the 17 months of the evaluation. It is predicted in future, that for the IOW NHS Trust there would be thirty-nine avoided face-to-face appointments per week[10] from a previous weekly total of 62, based on the 10 months when all IOW GP practices were on the teledermatology pathway. This represents estimated reduction of 63% from the original pathway. The appointments included relate to the initial part of a patient's pathway, from referral to initial review, since this is the part of the pathway affected by use of Dermicus teledermatology. Patients will continue to have other appointments as appropriate for the rest of their treatment. However, these results suggest triaging of patients through Dermicus teledermatology avoided unnecessary appointments for patients during the early part of their referral pathway. In addition, we can note that there is a 50% reduction in those attending face-to-face appointments for biopsy under the Dermicus pathway, as patients now only require the one appointment for the biopsy (avoiding an initial consultation as well). This suggests greater system capacity has become available. See table 3.

Table 3. Estimated pathway activity by outcome type

Outcome	Likely referrals generated by Dermicus	Face-to-face appointments under the original pathway	Face-to-face appointments under the Dermicus pathway	Avoided face-to-face appointments
Advice & Guidance	1,223	1,223	0	1,223
Biopsy	857	1,713	857	857
Review	344	344	344	0
Rejected/Referred Out	11	11	0	11
Unrecorded	25	25	25	0
Total	**2,459**	**3,316**	**1,226**	**2,090**

[10] Based on the 10 months that all practices were live with Dermicus

4.6.1 WAITING TIMES

A reduction in waiting times was one of the major benefits identified in the interim report that covered the two month period Jan to Feb 2020 . Outpatient data from February 2020 to May 2021 shows that waiting times for Dermicus teledermatology referrals continued to be much lower than non-Dermicus referrals of any type as shown in Table 4. Table 4 shows that the average waiting time from referral to first review remains less than a day for Dermicus referrals compared to between 10 and 47 days for other referral types. This is a further reduction from the 0.6 reported in the interim report and reflects the longer time period and data gathered, as well as covering all twelve practices on the IOW.

Table 4. Average waiting time in days between referral and first review

	Referral type			
	Two-week wait (not via Dermicus)	Urgent (not via Dermicus)	Routine (not via Dermicus)	Dermicus
Feb 20[11] - May 21	10.1	39.5	47.7	0.1

Short waiting times were sustained throughout the Covid-19 pandemic, including during periods of national lockdown, which suggests Dermicus was a particularly useful platform in light of growing delays and increased waiting lists seen elsewhere in the NHS at this time[12]. The patient questionnaires collected as part of this evaluation showed that patients found the reduction in waiting times to be a particularly valuable feature of Dermicus teledermatology.

4.6.2 EXPECTED AVOIDED APPOINTMENTS WITH THE DERMICUS PLATFORM

The IOW has a registered practice population of 145,390[13] and receives an average of 201[14] referrals for skin lesions a month, making monthly referrals to the Trust 1.4 per 1,000 population.

We have estimated that Dermicus can achieve a 63% reduction in face-to-face appointments by avoiding the need for patients to be seen at the hospital during the early part of the pathway. However, there are local factors that may have influenced the volume of referrals received by the IOW Trust since January 2020 that make it difficult to predict how many appointments another organisation might expect to avoid. Factors proposed by the Steering Group that might have affected referrals were:

- **Population age and cancer incidence**: An initial rationale for testing Dermicus on the IOW was because it had a higher-than-average proportion of older people (65+) than other parts of England[15] (see Table 5) and higher incidence of cancer is related to age coupled with the south of England, including the IOW, tending to have higher levels of sun exposure. However, recent sources suggest that the IOW NHS Trust has a lower rate of two-week referrals for suspected skin cancer than England, per 100,000. The two-week wait referrals for suspected skin cancer (all ages) are given as a proportion of 100,000 patients per practice list. For the IOW CCG this was 705 per 100,000 and for England: 767 per 100,000 for 2018/2019. However, this is not incidence of skin cancer diagnosis, which was not possible to evidence for the IOW.

[11] Tele-dermatology activity was not coded in the Isle of Wight Trust until February 2020
[12] https://www.kingsfund.org.uk/press/press-releases/kings-fund-responds-nhs-hospital-performance-statistics-waiting-lists
[13] https://digital.nhs.uk/data-and-information/publications/statistical/patients-registered-at-a-gp-practice/july-2021
[14] Based on referrals coded as Tele-dermatology in the Isle of Wight Trust data for the 10 months all practices were live with Dermicus
[15] https://digital.nhs.uk/data-and-information/publications/statistical/patients-registered-at-a-gp-practice

Age Range	IOW CCG	England
65+	28.3%	17.5%
75+	13.2%	8.1%
85+	3.7%	2.3%

Table 5. Age as % of GP registered population

- **GP increase in referral rates**: It was speculated that given the ease with which GPs can seek an expert opinion via the Dermicus teledermatology, less confident or experienced GPs might refer as a precaution. However, it is not possible to show that this was the case as only one GP was interviewed.
- **Impact of the Covid-19 pandemic on referral rates**: The lockdown may have resulted in reluctance by people to visit GPs with concerns about their skin lesions. The Dermatology Consultant reported this was potentially a factor that influenced referral rates, later perceived to be increasing, see section 4.7.
- **Impact of media coverage**: During the evaluation period two prominent media events occurred that may have impacted on increasing referral rates; however, this is only speculative:
  - During the summer of 2020, a young patient sadly passed away due to a melanoma. This became a high-profile case on all forms of local media raising melanoma awareness.
  - Dermicus was a finalist for a Health Services Journal award which attracted media coverage, thus increased awareness.

Further economic evaluation is required to establish links between teledermatology and referral impact and avoided face-to-face appointments. In addition, the analysis relates only to avoided face-to-face appointments. Other relevant economic factors include the time commitment required for consultants to review the images, as well as set-up costs, for example, the purchase of equipment such as dermatoscopes and mobile phones and time spent on staff training. In addition, different operational models such as skin clinics might involve adminstrative costs, so would also benefit from further evaluation.

4.7 IMPACT OF COVID-19 PANDEMIC ON DERMICUS ROLLOUT TO GP PRACTICES ON THE ISLE OF WIGHT

The Covid-19 pandemic presented an extraordinary event that impacted on the evaluation. Therefore, it was challenging to both data collection and the ability to conduct a fair assessment of the performance of Dermicus teledermatology. However, this presented an opportunity for the teledermatology pathway to 'shine.' Most of the interview informants suggest that access to the Dermicus platform made dermatologist reviews of lesions possible during the Covid-19 pandemic. The Dermicus teledermatology pathway also provided the required flexibility to adapt to the new ways of working (virtually and remotely) imposed by the Covid-19 pandemic.

> *"It meant there was no interruption to their service"* [GP lead]

For patients who did present with lesions during the Covid-19 pandemic, most informants felt the Dermicus platform reassured them that a dermatologist saw their lesion.

> *"To be able to do that remote, and feel confident that what the doctor was seeing was what they would see here, […], that interaction was absolutely perfect"* [Lighthouse Manager]

Nonetheless, there was a perception that patients delayed seeking treatment for lesions during the Covid-19 pandemic despite there being a Covid-secure pathway in place.

> *"Now we're seeing the patients that obviously had a second vaccine, […], patients now feel comfortable to present and to come out into the clinic setting. I get the feeling that the numbers are going to go up again"* [Dermatology Consultant]

There are implications and concerns nationally that the Covid-19 pandemic has impacted significantly on the incidence of skin cancer raising concerns for patients who have not received a timely diagnosis and therefore how the role of remote monitoring could, and should play, in the future of skin cancer care (Venables et al 2021).

4.8 CONSIDERATIONS FOR IMPLEMENTATION OF DERMICUS TELEDERMATOLOGY

Most interview informants were experienced and expert. A range of considerations raised in the interviews for future implementation were sense checked with the key stakeholder group for this project, the Steering Group. Table 6 provides a summary of the range of issues raised and the group's recommendations to address these issues. The full stakeholder response and evidence for the issues raised is available at Appendix 4.

The considerations cover service delivery, organisational issues, training, and upgrades to the Dermicus teledermatology platform.

Table 6. Summary of considerations for future implementation of Dermicus teledermatology

Considerations	Recommendation
Ongoing training requirements	
Health care professionals perceive that some patients have limited understanding that the image taken is received and reviewed virtually by the platform dermatologist. They also perceived that younger patients rather than older patients were more able to understand the rationale for introducing the Dermicus platform.	Staff training should ensure they can communicate the new pathway effectively to all patients and sympathetically to older patients to take into consideration various levels of understanding of the rationale for Dermicus.
A reliable and resilient service needs enough trained staff to cover annual leave or staff sickness.	To maintain the teledermatology pathway requires training across the GP practice workforce to ensue more than just the champion or a selected few staff are trained.
A health care professional may wish to seek feedback on an image from another clinician without necessarily making a referral to a service.	Include information regarding the 'consensus' facility to referrers / reviewers as a standard part of their training and education.
Timing out from the Dermicus platform when inactive was frustrating.	Include information regarding the requirement to check the setting on iPhones provided to stop the phone going to sleep so the platform does not lock as a standard part of their training and education.
The time taken to complete a referral using the Dermicus platform is longer than that required to do a two week wait referral via SystmOne due to differences in the level of information required.	Include information regarding the rationale behind increased length of time for referral completion (for richness of diagnosis), by using a process map to justify additional time, as a standard part of their training and education.
Health care professionals in GP practices have received unwanted email notifications regarding the outcomes or diagnosis of referrals made by other clinicians within the referring GP's practice.	Include information regarding how to set up email notifications as a standard part of their training and education.
The quality of photographs is variable, affected by lack of time and/or experience of the referring Health care professional.	Provide regular education and training sessions to staff to ensure feedback on image quality is provided, and specific training requirements can be met. This regular training should include information regarding upgrades to the Dermicus platform (e.g., AI feature which will be available in Dermicus soon to prompt if photos are of inferior quality).
Upgrades proposed	
Automated ticket into SystmOne to increase interoperability.	Now possible to use IM1 pairing integration (NHS standard) so that everything is automatically stored in the GP system. System functionality can be tailored to suit the unique needs of the adopting site.
Ability to sign consent without the need to photograph the information leaflet likened to the	Review process of gaining consent and upgrade this process in line with infection control and information governance requirements.

postal service's recording of signatures using a handheld device.	
Backend Dermicus interface requires improvements to increase aesthetic appeal and provide greater retrievable data and improve output reports.	Development of exports can be facilitated to support the creation of graphs and more user-friendly outputs, for example development of a dashboard / portal.
Retaining the photographs in the existing electronic systems to increase interoperability in multiple ways.	Development of integrated systems, which needs to be configured at local NHS trust level.
Awareness by staff of alternative platforms that offer additional features not offered in Dermicus to understand, where possible, other opportunities for the development of the Dermicus teledermatology.	Decision for NHS trusts / CCGs/ GP practices regarding what they commission / procure considering the benefits of different teledermatology platforms.
Organisation of teledermatology	
Location and storage of the equipment needs to be accessible and numbers of dermatoscopes and phones assessed.	Decision for NHS trusts / CCGs/ GP practices to determine the amount of equipment required by sites, and to monitor this requirement, and whether 'skin clinics' (defined as a clinic allocated for patients with suspicious lesions from a triaging eConsult appointment) are introduced to mean a single practitioner requires equipment, so equipment can be less widely spread. This is better addressed by ensuring each practice has a site-specific plan of where to locate, charge and / or store the iPhone and dermatoscope for sharing.
Expand to use with other dermatological conditions.	Decision for NHS trusts / CCGs/GP practices regarding use and what they commission / procure for other dermatological conditions.
Administration of the platform requires full time admin support to transfer data between the Dermicus platform and the local patient management system and can present risks because manually transferring information could result in errors.	Decision for NHS trusts / CCGs/ GP practices to determine how to manage the administrative element and that this presents an additional cost to support the operation of Dermicus. To also note: The administrative process implemented in this evaluation was specific to IOW and the Lighthouse Medical Limited as the provider, and could be a unique model for this context, and require local adaptations to ensure the admin support is feasible to implement.
Adequate Wi-Fi access and mobile data may result in additional costs, e.g., mobile data SIM card.	Decision for NHS trusts / CCGs/ GP practices to determine Wi-Fi access in GP practices and if additional costs apply.
Pricing and cost of the Dermicus platform requires consideration by commissioners and providers.	Commissioners and providers can access detailed licensing and training information for Dermicus in the NHS Digital GP IT Futures Framework. https://buyingcatalogue.digital.nhs.uk/solutions/covid19/10022-001
Maximising learning opportunities between GP practices to improve proficiency of Dermicus integration. For example, advanced health practitioner allocated to take photographs and complete Dermicus referral via a "skin clinic" rather than the GP completing Dermicus referral during consultation.	Decision for NHS trusts / CCGs/ GP practices to ensure shared learning occurs and there are feedback mechanisms in place to ensure there is continual learning and improvement.

In addition, the opportunity to conduct a full body scan for some patients was another issue raised. This is an issue for teledermatology, and not Dermicus specifically (Gerhardt et al 2021). Training of NHS staff was a key factor that emerged. Gnosco AB provided two physical training sessions at the IOW in the early stages of the roll out. Training responsibilities were subsequently transferred to LML. Gnosco AB report that they offered extra training to staff newly assigned to Dermicus because of reduction in staff at LML that led to pressure on resources allocated to training.

5.0 SUMMARY AND CONCLUSIONS

The evaluation of the Dermicus teledermatology has undergone an extraordinary test under the Covid-19 pandemic and so the evaluation findings should be read through the lens of this unique event which opportunistically identified both benefits and limitations.

Patients, primary care staff, and the dermatology consultant, found Dermicus teledermatology easy to use and efficient in providing a quick diagnosis that avoided unnecessary attendance at outpatient clinics. This was particularly significant for the IOW as NHS outpatient dermatologist services were not available on the island. A key framework proposed in the evaluation specification (MAST, Kidholm et al 2012), (Appendix 1) indicates that Dermicus teledermatology overall meets with the expectations and standards for technical useability and clinical functionality. Appendix 5 provides a detailed response to the MAST framework.

The experience of implementation raised issues for both Dermicus teledermatology, and teledermatology more generally. The complexity of NHS trust IT and patient management systems indicates that implementation of teledermatology will need to adapt to local trust circumstances to permit optimal integration and interoperability between systems. Organisation of workforce training needs to be embedded and routinised to enable resilience in managing teledermatology. Finally, future evaluation of teledermatology should consider benefits and differences between different teledermatology platforms, conduct a more detailed cost analysis than was possible in this real-world evaluation and investigate the implementation spread and adoption implications to other NHS trusts of Dermicus teledermatology due to the uniqueness of the IOW NHS Trust context.

5.1 LIMITATIONS

As previously mentioned, the Covid-19 pandemic impacted on the planned use of pre intervention referral activity data in lieu of a control group for comparison. This was because all practices within the Trust were engaged in the use of Dermicus. Instead, new activity was compared to anticipated activity, based on historical trends.

It was not possible to conduct the planned cost analysis and therefore not assess cost savings achieved with the Dermicus teledermatology pathway. It is not possible to give a conclusive answer as to how much money could be saved with the use of Dermicus teledermatology and outcomes based on avoided activity.

The IOW is a unique location being an island off the south coast of England. Factors such as population and social differences should be considered when applying any findings to the wider population. Overall, IOW has a much older population, and due to the insular nature of living on an island, their activity may not be representative of the mainland population. In other words, patients on the mainland have access to wider NHS resources due to greater geographical connectivity, whereas patients on the IOW need to travel for specialist treatment, which is not so easy across the Solent.

Lack of interview data from GPs and other staff across the 12 practices on the IOW does not provide a representative perspective from primary care. The lead GP indicated, given their experience on the IOW and familiarity with GP practices, some practices fared better than others at implementing Dermicus teledermatology.

> *"In one practice it really doesn't work quite so well"* [GP lead]

5.2 IMPLICATIONS FOR SCALE UP AND SPREAD OF DERMICUS

Teledermatology has shown that it provides an opportunity to manage effectively and efficiently referrals for skin lesion review (Ho et al 2013) preventing unnecessary presentation to outpatients of non-cancerous lesions that can be managed sufficiently in primary care. A teledermatology roadmap (Implementing safe and effective teledermatology triage pathways and processes - A Teledermatology Roadmap for 2020-21 v3.0 available on

The Elective Care Community of Practice Dermatology workspace on the Future NHS Collaboration Platform) provides guidance on the implementation of integrated teledermatology. Different teledermatological platforms have developed in response to an increasing need to have a teledermatological solution. Dermicus teledermatology is one such solution. This real-world evaluation showed clear benefits to teledermatology implementation with Dermicus, particularly in response to the Covid-19 pandemic. Key implementation points raised covered:

- Ensuring a proactive training programme of the primary care workforce and consultant dermatologists and advanced health practitioners in secondary care to embed teledermatology
- Informing patients about teledermatology to ensure its key objectives are understood and allow patients a face-to-face consultation when requested
- Full consideration of the organisational issues for managing equipment (dermatoscopes and iPhones), ensuring enough staff are trained and adaptations necessary to individual NHS Trust referral pathways
- Acknowledgment of the additional benefits of teledermatology in improving diagnostic skills in primary care, enabling use of images at multi-disciplinary team meetings, and providing useful data for audit and research purposes.

Interoperability optimisation of Dermicus teledermatology for other NHS trusts involves system configuration such as the national systems of the Patient Demographic Service (PDS – the NHS Spine), Electronic Referral (e-RS) and TPP(SystmOne). Future evaluations might consider how well these configurations operate in delivering both teledermatology and specifically Dermicus teledermatology. Finally, Dovigi and colleagues (2020) in a recent systematic review acknowledge the overall success of teledermatology. However, they indicate challenges to real world integration and adoption remain and propose future research applies an implementation framework to improve understanding of barriers and facilitators to ensure the ongoing successful implementation of teledermatology. The Normalisation Process Theory framework (May et al 2009), used in this evaluation, is an example of an implementation framework.

5.3 FUTURE RECOMMENDATIONS FOR EVALUATION OF DERMICUS AND TELEDERMATOLOGY

Ideally, it is recommended that future evaluations compare pre and post intervention outpatient activity and referrals into dermatology. Identification of skin lesion activity within these pathways, to isolate teledermatology patients, will allow not only review of changes in pathways and attendances, but also cost codes that can more accurately predict cost savings due to teledermatology. There will always be fluctuations in activity due to external factors (e.g., seasonal changes and winter pressures), however if the review period is long enough, these can be considered. In addition, comparison with a control group (either not using teledermatology or not using Dermicus teledermatology) will enable more confidence in outcomes achieved. Patient questionnaires provided sufficient information and could continue as an ongoing audit of patient experience. Future evaluations should consider a deeper dive into impacts on the primary and secondary care workforce. GP practice insights were limited in this real-world evaluation. Finally, diagnostic accuracy was not undertaken as part of this evaluation. A systematic review of teledermatology studies between 2005 and 2016 compared diagnostic accuracy between face-to-face appointments and teledermatology concluded that face-to-face was better for diagnostic accuracy (Clark et al 2018). However, review authors also noted that both software and hardware (mobile phones) were continuously improving. Commercial dermatology platforms such as Dermicus are required to comply with certain standards, including evidence standards (e.g., DTAC), and Dermatology services are guided by the roadmap for teledermatology. LML as a matter of routine good practice conducted separately a diagnostic audit of diagnoses via teledermatology.

6.0 REFERENCES

Clark, A.K., Bosanac, S., Ho, B. et al. Systematic review of mobile phone-based teledermatology. Arch Dermatol Res 310, 675–689 (2018). https://doi.org/10.1007/s00403-018-1862-4.

Gerhardt CA, Foels R, Grewe S, Baldwin BT. Assessing the Diagnostic Accuracy of Teledermatology Consultations at a Local Veterans Affairs Dermatology Clinic. Cureus. 2021;13(6): e15406. Published 2021 Jun 2. doi:10.7759/cureus.15406

Kidholm K, Ekeland AG, Jensen LK, Rasmussen J, Pedersen CD, Bowes A, Flottorp SA, Bech M. A model for assessment of telemedicine applications: MAST. Int J Technol Assess Health Care. 2012 Jan;28(1):44–51

May, C.R., Mair, F., Finch, T. et al. Development of a theory of implementation and integration: Normalization Process Theory. Implementation Sci 4, 29 (2009). https://doi.org/10.1186/1748-5908-4-29.

Ho B, Lee M, Armstrong AW. Evaluation criteria for mobile teledermatology applications and comparison of major mobile teledermatology applications. Telemed J E Health. 2013 Sep;19(9):678-82. doi: 10.1089/tmj.2012.0234. Epub 2013 Jun 28. PMID: 23808886.

Janda, M., Swetter, S., Horsham, C. and Soyer, H. (2020), Virtual melanoma checks during a pandemic. Br. J. Dermatol., 183: 752-753. https://doi.org/10.1111/bjd.19255.

Venables, Z.C., Ahmed, S., O. Bleiker, T., Broggio, J., Kwiatkowska, M., Levell, N.J., Millington, G.W.M., Paley, L., Payne, E., M. Proby, C., Vernon, S. and McPhail, S. (2021), The impact of the COVID-19 pandemic on skin cancer incidence and treatment in England, 2020. Br J Dermatol, 185: 460-462. https://doi.org/10.1111/bjd.20409.

Primary Care Commissioning, British Association of Dermatologists, Quality standards for teledermatology – Using 'store' and 'forward' images, 2011.

7.0 APPENDICES

Appendix 1 – Mast Framework

Appendix 2 – Data collection table

Appendix 3 – NoMAD survey

Appendix 4 – Considerations for implementation

Appendix 5 – Completed Mast Framework