

Overview of Digital Transformation and Telemedicine during COVID19

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Introduction

The SARS-CoV-2 (COVID-19) global crisis has served as a catalyst for transformation of digital healthcare and telemedicine. By necessity, healthcare providers are having to accelerate development and implementation of these tools in order to maintain services. The World Health Organisation describes telemedicine (the ability to diagnose and treat patients remotely via telecommunications technology) as an essential service for clinical services and decision support [1]. This is particularly relevant in ophthalmology for two reasons:

- prolonged exposure in close proximity between doctor and patient on the slit lamp which may increase the risk of transmission and viral load [2,3]
- the ability to make clinical decisions on structured examination metrics (such as palpebral aperture, intraocular pressure or cup disc ratios) and images.

There are a number of classes of digital tool available, in addition to video-conferencing platforms, which can support care and working during this unprecedented time:

1) Communication

Videoconferencing

Virtual triage/referral refinement

Secure messaging platforms

2) Patient self-monitoring

Home vision assessment

Smart phone based self-monitoring tools

Smart phone based imaging tools

3) Management and team Planning

4) Mental health and holistic support

Communication

In this pandemic, rapid implementation of virtual and remote communication to support established care pathways is vital in order to reduce the amount of time spent in close proximity with patients.

The duration of this pandemic is unknown, some predicting it to last up to 18 months if we are successful in “flattening the curve”. The use of digital communication will have to evolve from a predominantly triage role to one that includes “smart history-taking”, robust clinical assessment and management of disease. A critical component will be the ability to transfer images with the data and quality necessary for clinical use.

Remote tele-examination of an eye in 4K resolution using 5G broadband has already been piloted in NHS Forth Valley and Moorfields Eye Hospital, allowing remote examination of patients [4]. The implementation of this technology will lend strength to the following tools.

Video-conferencing for consultations

The objective of video-conferencing during the pandemic is to keep face-to-face exposure at a minimum. It can be used for triage, the consultation itself, management and counselling – this is what most people mean by “telemedicine”.

There are number of different applications and software options for telemedicine, some of which have already been piloted in the NHS. These include products such as [Attend Anywhere](#), [Consultant Connect](#) and [Zoom for Healthcare](#), which lend themselves to the clinical workflow by incorporating a virtual waiting room system. NHS Digital has just published a list of approved video consultation platforms for use in general practice, although the majority of these platforms are focused towards primary care. [5]

Video consultation has until recently not been widespread in ophthalmology. However, a pilot running in Forth Valley using NHS Near Me (based on Attend Anywhere) has been supporting management of patients in optometry practices by hospital ophthalmologists using live-streaming of slit lamp examinations and screen sharing of imaging devices. During the pandemic, Moorfields has deployed video consultations (using Attend Anywhere) at scale, allowing patients at home to discuss their symptoms with an ophthalmologist rather than visit A&E. Over 2,500 video consultations have been conducted, and volume is now approaching 100 per day, with the vast majority of these patients managed at home. This is now expanding into the subspecialty outpatient clinics. These exemplars suggest that video-consultation, appropriately deployed, has a significant role to play in our long-term practice.

Data protection guidelines need to be considered when choosing which platform to use for ophthalmology consultations. In the United States, HIPAA compliance rules are used to ensure that electronic protected health information (EPHI) is secure, not vulnerable to accidental or malicious breaches, and only accessible by authorized users [6]. They also require mechanisms in place so communications can be monitored and remotely deleted if necessary, and for an automatic log-off to occur if a systemic is unused for a period of time. Applications which self-report as HIPAA-compliant should be prioritised, in order to ensure security of data and conformity with General Data Protection Regulation (GDPR) [9]. Unsecure channels of communication such as SMS, WhatsApp, Skype and email are considered risky for communicating EPHI at distance, particularly as they remain on service providers’ servers, and contain identifiable healthcare information.

HIPAA compliant telemedicine providers* [8]

Name and website	Pricing
AccuRX* - https://www.accurx.com/	Free for NHS Use
Attend Anywhere* - https://www.attendanywhere.com/	Free for secondary care (Procured by NHSE. Usually £264-312 per user per year
BlueJeans - https://www.bluejeans.com/use-cases/healthcare	\$9.99 for Bluejeans Standard, \$13.99 for Bluejeans Professional
Doxy - https://doxy.me/	Free (no HD) to \$35 professional, \$50 clinic
Google G Suite Hangouts Meet https://gsuite.google.com/intl/en_uk/pricing.html	£4.14 per user per month for Basic, £8.28 per user per month for Business and £20 per user per month for Enterprise.
Microsoft Teams/Skype for Business https://products.office.com/en-gb/microsoft-teams/group-chat-software?rtc=1	Free for Microsoft Teams, £3.80 per month for Business Essentials, £9.40 per month for Business Premium
TopDoctors – https://www.topdoctors.co.uk	Reported free and by invitation only
Trustedoctor https://trustedoctor.com/	Contact directly for pricing/Not provided on site
Updox https://www.updox.com/	Contact directly for pricing/Not provided on site
VSee https://vsee.com/	Basic from \$49, Enterprise “Contact Sales”
Zoom for Healthcare https://zoom.us/healthcare	Basic Free. Pro £11.99/month. Business 15.99/month

*Note providers self report as compliant. AccuRx, AttendAnywhere and TopDoctors do not self-report as HIPAA-compliant, however meet the listed criteria

Information Governance during Covid

NHSx has issued updated guidance regarding information governance for the unique circumstances of the Covid 19 crisis, acknowledging that in certain cases “the benefit can outweigh the risk” [7]. Its new guidance includes a strong indication from the Information Commissioner about flexibility at the current time [10]: *“The health and social care system is going to face significant pressures due to the COVID-19 outbreak. In the current circumstances it could be more harmful not to share health and care information than to share it. The Information Commissioner has assured NHSX that she cannot envisage a situation where she would take action against a health and care professional clearly trying to deliver care”*. Therefore, where the aforementioned apps are not available, “it is fine to use video conferencing tools such as Skype, WhatsApp, Facetime as well as commercial products designed specifically for this purpose” [9]. However, it is important to avoid video communication applications which are public-facing, such as TikTok, Twitch, Facebook Live.

Various new HIPAA-compliant free-to-use videocall sites have also emerged, enabling COVID19 afflicted patients to communicate with healthcare providers [11]. The coming weeks are likely to see the rapid development and implementation of numerous other free integrated telehealth options.

Virtual Triage

“Forward triage” is a strategy used to manage surges in healthcare demand [12]. This refers to the division of patients into groups on the basis of risk and need before they are seen by a healthcare provider, and is a key step in reducing face-to-face consultations at times where there is increased

risk to patients, staff and the wider community. This approach has been used by most hospital eye units to decide which of their current patients can be deferred and rebooked and which need ongoing care either virtually or face to face and is now being rolled out nationally for referrals from optometrists.

Cloud-based platforms such as [Big Picture Medical](#) [13] provide a virtual link between ophthalmologists and community opticians, enabling scrutiny of high resolution images at distance. To be successful, triage protocols will need to incorporate images as well as clinical history and objective measurements (such as visual acuities and intraocular pressures), which will require integration of these platforms with other digital health tools such as self-monitoring applications.

Instant messaging and phone calls

In a rapidly changing healthcare environment, instant messaging can be vital to quickly inform patients about changes in scheduled appointments, and offer guidance relating to appointments and management plans. There are, however, important data protection considerations surrounding the use of these systems. These are highlighted by NHS Digital [14], which emphasizes the importance of these five characteristics:

Requirements of Instant Messaging Apps

- 1. Encryption:** Does the app meet the NHS end-to-end encryption standard of “AES 256”?
- 2. End-user verification:** Can the app verify that the people using the app are indeed who they say they are?
- 3. Passcode protection:** Can a secondary PIN be used to protect the app, and can it be time-out enabled?
- 4. Remote-wipe:** Can the messages be removed if the device is lost, stolen or redeployed to another staff member?
- 5. Message retention:** Does the app allow automatic deletion of messages after a set period of time?

Examples of instant messaging platforms which provide these facilities include [Hospify](#) [15] which combines secure messaging and image capture, and [Pando](#) [16] which additionally integrates patient lists into the platform

Ideally, apps such as WhatsApp, Viber and Telegram should be considered *“Only use a standalone instant messaging application if your organisation does not provide a suitable alternative”*.

In situations where patients need to be called or messaged using personal devices, NHS Digital suggests minimising the amount of patient identifiable data communicated, and to maintain comprehensive and separate clinical records. To ensure all parties and the data is protected, it is paramount that no one else uses a personal device, passwords or passcodes are set (which lock out

after a period of not being used), message notifications on lock-screen are disabled, and the remote-wipe feature is enabled in case the device is lost or stolen. For phone calls, it is important to hide the caller ID.

Clinicians should also be aware that instant messaging conversations can be subject to freedom of information and subject access requests.

Patient self-monitoring

Given the duration between hospital appointments for many cases will now be markedly prolonged, this is a time for patients to be empowered through home monitoring. This is especially pertinent when dealing with stable and chronic diseases such as dry AMD or diabetic macular oedema.

Once this crisis is resolving, we hope that this experience may provide the framework for improved patient-centred management, with the individual patient better placed to direct their own healthcare needs. Cloud-based platforms, for example [Patient Knows Best](#) [17], enable patients to have control over access to their records, enabling for a direct means of communication between healthcare providers and the patient, and also synchronizing with videoconferencing platforms such as Attend Anywhere.

Home vision testing

Visual acuity testing can be carried out with a number of applications, of which the most suitable are tools which are fast, accurate, easily repeatable, and do not collect personally identifiable data. Due to their ubiquity in modern life, smartphone-based solutions are perhaps the most suitable choices.

Examples include [Peek Acuity](#) [18], which has been used for remote monitoring of visual acuities, particularly in challenging circumstances in rural Africa. [The College of Optometrists](#) have also released a [simple A4 visual chart](#) [19] which can be printed and used by patients at home.

Tools for monitoring visual acuity in children include the [Kay iSight Test Professional](#) app [20], which can be used to record near and distant vision in children from 18 months and above. This has been made free to use for six months.

Smartphone-based self-monitoring tools

Due to the ubiquity of the host devices, smartphone-based tools have the potential to increase quality of, and access to, care. These can span apps which allow patients to self-monitor, to ones which enable smart history taking for clinicians, via a decision-tree.

Currently, successful implementation is most observable in devices which allow for self-monitoring. Enabling patients to characterise and monitor their metamorphopsia remotely can be very useful for monitoring patients with chronic retinal conditions. [Alleve](#) [21] is a self-monitoring app which assesses hyperacuity using an alignment task. This appears to be accurate in detecting wet AMD and also reasonably accurate in classifying dry and wet AMD [22]. The patient reported outcome measures can be monitored remotely by Ophthalmologists.

[Okko Health](#) [23] bridges the gap between a monitoring tool and a game to allow remote monitoring of metamorphopsia, again to help observe conditions such as age-related macular oedema and

diabetic macular oedema. We know that “gamification” can increase user experience and engagement [24], which may be an important attribute in home monitoring tools which might otherwise seem boring if used repetitively over weeks or months.

Challenges in home monitoring:

Monitoring of vision at home brings with it many challenges, and deployment of these technologies must be undertaken with a safety net to ensure correct use and reliable clinical data. Challenges include:

- 1. Digital exclusion** describes challenges in accessing or using digital technologies. Many at-home monitoring systems place additional constraints beyond ownership of a smartphone, for example being available only for iOS rather than the larger Android market.
- 2. Device variability** is an ever-present challenge in designing home vision tests, and uncertainty over screen size, resolution, and display characteristics can place an upper ceiling on test quality.
- 3. Convenience** can be a challenge when only a one-off test of vision is required, as is the case for many of our patients. Most vision testing apps require app download, as well as sign-up and onboarding. This is a significant overhead for the patients who might only use the product once.
- 4. Dealing with the results.** Large scale use of home monitoring creates a large incoming datasource that must be managed by the hospital, with robust clinical governance processes in place to ensure that all results are reviewed and actioned.

Smart-phone based imaging tools

Regular retinal imaging can be essential for monitoring conditions such as diabetic retinopathy and exudative age-related macular degeneration. The development of camera adapters and mobile-phone based retinal imaging systems have already been used in the field, principally in remote areas. An example of this is the [Peek Retina](#) system [25].

Home OCT devices such as that provided by [Notal Vision](#) [26] have also been developed for use in exudative age-related macular degeneration. These are yet to be clinically approved in the United Kingdom but may provide another option for remote digital diagnosis.

Management and team planning

This is an extraordinary time for rota management, as timetables are changed at short notice, and doctors are moved between clinics and hospitals to allow for provision of healthcare where it is needed most. New guidance needs to be developed for managing patients, and teams need to work together whilst not being in the same physical place.

The tele-conferencing and communication apps described in the communication section above can all be used to support remote team and staff interaction requirements. Again, where patient details

or confidential information are being shared, similar information governance requirements need to be considered as for when these are used for patient care. For example [Microsoft Teams](#), which is a combined videoconferencing and team management platform, albeit lacking the features in aforementioned platforms such as virtual patient waiting rooms.

The sphere of training and education has had to make a necessary online shift during the current pandemic. Microsoft Teams can be used where confidential information is included as part of the educational session, for example when discussing cases for postgraduate training. Where confidential information is not included as part of the educational session, platforms such as [Blackboard](#) [27] provide a simple virtual classroom environment which facilitate student involvement in the session.

Project management tools can be useful for keeping teams working synchronously during these rapidly changing environments, by acting as a virtual “office”. Examples of these include [Basecamp](#) [28], [Yammer](#) [29] and [Teamwave](#) [30]. The objective here is to ensure that teams can communicate, plan and track updates in real time.

Mental Health and Holistic Support

The impact of a global pandemic psychologically on a population, and one individuals, cannot be underestimated. For a number of patients and for staff, staying indoors and self-isolating for long periods of time will understandably have an impact on their mental health. [Mind.org.uk](#) provides general advice for wellbeing during self-isolation [31] and [NHS One You](#) [32] also provides a list of helpful resources and platforms to help with stress, anxiety and mood.

Sharing and being part of a community can also be very important for patients in these difficult circumstances, with practical advice that only fellow patients might have. [HealthUnlocked](#) [33] is a social platform which allows patients to find and connect with others who have the same health condition. The groups are administered by separate organisations, for example the [Macular Society](#).

For healthcare workers such as ophthalmologists, the unique pressures and uncertainties in work and home life, and the fear of re-deployment to general medical care for which they can feel they do not have the competency to undertake safely, can also lead to anxiety and depression [34]. It is important to safeguard mental health during these challenging times. NHS workers have been granted access to a number of mental health apps to support their health and wellbeing until December 2020 [35]. These include platforms to help stress and sleep such as [Sleepio](#) [36] and [Unmind](#) [37], apps which help with mindfulness and meditation (such as [Headspace](#) [38]), and [Daylight](#) [39], a platform which teaches cognitive behavioural methods for managing worry and anxiety.

Conclusion

If these extraordinary times have one positive outcome, it will be a rapid digital transformation of healthcare, which will have a positive impact on access to healthcare, remote diagnosis and delivery

of services beyond the duration of the COVID-19 crisis. Through this experience, the way we practice ophthalmology may be sustainably changed for the better.

Nevertheless, the new platforms and approaches which emerge from this period should be subject to constant evaluation, so that they meet the standards we would expect in ordinary times.

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