NHS Forth Valley

Real-Time Tele-Ophthalmology in the Emergency Department

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The Royal College of Ophthalmologists has recently commissioned work to deal with the growing demands of patients presenting to the Emergency Department (ED). Research has shown that there has been a change in health seeking behaviour since 2004 which coincided with the change in GP out-of-hours contract and the implementation of the 4 hour waiting target in ED (**Figure 1**). Patients who would previously attend their GP now find the ED a more attractive option. To manage this steady rise in demand, tele-ophthalmology is currently being utilised as a screening tool in diabetic, macular and glaucoma clinics. It has also proven useful in treating patients in rural areas where there has been little or no access to healthcare.

NHS Forth Valley caters for ~300,000 population. During office hours, a specialist ophthalmic nurse is first point of contact for all referrals. Outside office hours, the Ophthalmology Consultant is First On-Call. The present Test of Change involves replacing the traditional standard of telephone triage (phone discussion between clinical staff) with a video consultation (Skype for Business) from a slitlamp-mounted mobile device (apple iPad) aligned with a bespoke adapter enabling a high fidelity bio-microscopic live feed of the patient's eyes.
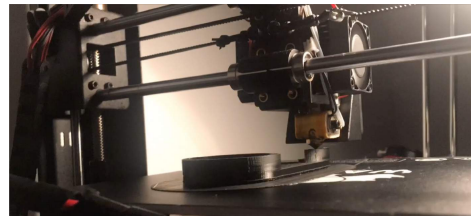

Figure 1: Annual Accident and Emergency Attendances 1987-2013 (source: Kingsfund.org.uk)

Aim: Does video-call-enabled, slitlamp-mounted mobile technology offer an efficient real-time tele-ophthalmology solution?

METHODOLOGY
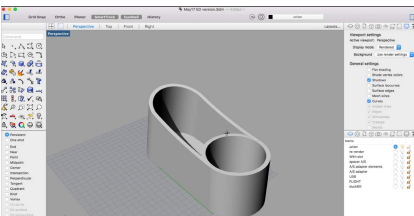
2A Slitlamp adapter designd in Rhinoceros 3D (R McNeel & Assoc.)

2B 3D printing of the adapter (Wanhao Duplicaor i3)

2C Mount connecting oculars to iPad

2D View from iPad, relayed via video call to on-call ophthalmologist

Phase 1: *Preliminary audit of the Rapid access clinic (RAC).* Data over a 2-week period was collected and analysed specifically looking at the source of referral, diagnosis and outcome.

Phase 2: *Creating and testing the system.* We designed (2A) and 3D printed (2B) a slit-lamp adapter, mounting a tablet device (Apple iPad) to the ED slitlamp (2C, 2D,3A), and evaluated the value of live video calls regards communication between ED/MIU and ophthalmology teams.

Phase 3: *Trialling the system and evaluating patient and clinician perceptions through use of questionnaires.* The system was then trialled and user satisfaction was evaluated using questionnaires developed by the research team. There were a total of 25 participants. Questionnaires included a combination of closed and open-ended questions, Likert scales and semantic differential scales. Participation was voluntary. No patient identifiable information was collected. Questionnaires were completed and placed in a pre-labelled envelope and sent to a lone analyser for independent evaluation

RESULTS

Phase 1: Internal audit demonstrated ~19 patients are seen in the acute eye clinic daily, of which 10% come from the ED. Front-of-eye problems comprised 47% (**Figures 3D,4A and 4C**).
Such anterior segment pathologies are most amenable to the proposed Tele-Ophthalmology System.
Over the two-week period, 19 patients were discharged on the same day, implying that total same day discharges *may* account for about one clinical session every two weeks.
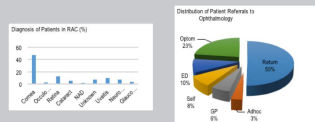

3. The makeup of the Rapid Access Clinic (RAC) in Ophthalmology, by ophthalmic subspecialty (left panel) and referral source (right panel)

Phase 2: Trials were initially undertaken with various mobile devices over various internet connections (3G, 4G, Wi-Fi) but a slit lamp on hospital Wi-Fi with iPad provided the best combination of equipment for video consultation.

4A. ED slitlamp with bespoke adaptor aligning iPad optics with slitlamp eyepiece. iPad screen serves as digital viewfinder during Skype call across site from hot site (FVRH or MIU) to Falkirk Community Hospital (cold site) on-call ophthalmologist
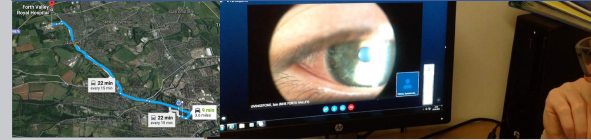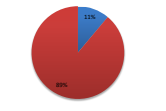
4B. Obviated journey for either ophthalmologist or patient

4C. View from on-call perspective. Consultation proceeds between ED clinician/patient /eye doctor

Phase 3: Patient and physician feedback suggest that the system reduces consultation time, provides a high level of clinician/patient satisfaction (**Figure 5A, 5B**) and positive impact regards to obviated clinic appointment (5C), clinical time (5D), patient encounter time (5E) and educational value (5G). Presented data reflects completed forms from 17 clinicians and 8 patients. With the present system, 2-3 video calls from ED/MIU were conducted each week. If used by all consultants, this would extrapolate to 8-16 video consultations per month. Additional cited benefits included: feedback for teaching, person centred care, electronic patient record improvements, increased range of to-take-out medicines for MIU identified, and the range of treatable conditions at presentation was increased.
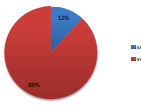
All clinician respondents (17/17) judged this acute Tele-Ophthalmology modality to positively alter decision making and follow-up arrangements for acute eye presentations to the ED or Minor Injuries Unit (MIU). All Patient respondents (5A) and Clinician respondents (5B) were satisfied with tele-ophthalmology modality as a referral system. >70% teleophthalmology consultations were judged to obviate a secondary care clinic appointment. This statistic captures same-day discharges from ED, as well as instances where the video-call review replaced the first of several follow up review appointments in the eye clinic.
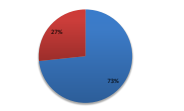

5A Patient Satisfaction Questionnaire Results

5B Clinician Satisfaction Questionnaire Results (ED, MIU, Ophth)

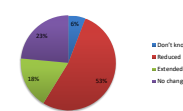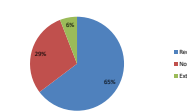5C Clinician perception of whether further secondary care appointment was prevented
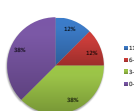
5D Impact on overall clinical time, as judged by clinicians

5E Clinician perception of overall patient encounter time (from presentation to discharge)
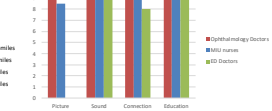
5F Patient length of travel

5G Call quality* and Educational Value: Feedback from clinicians
*NB Due to error on early feedback forms, ED doctor form was incomplete, so no judgement documented for call quality captured for this subset

DISCUSSION

Slitlamp adapter
Tablet vision testing apps (iSight test Pro, KayPicures ltd)
Retinal adapter (peek retina)
PhotoBluminator II (Eidon medical)

6. The FV TeleOphthalmology "Eye Pad" Kit

There is a steady rise in the number of patients presenting to the EDs with no commensurate rise in the number of clinicians or resources. Tele-ophthalmology offers a new way of working which has the potential to improve triage efficiency, reduce waiting times, allow for immediate expert opinions, offer real-time feedback and facilitate more effective teaching. It is not a replacement for face-to-face consultation, but rather a tool to assist with triage and management of patients, replacing the present standard of care for referral, a voice phone call.

The present test of change provides promising results in terms of patient/clinician satisfaction, time-saving and prevention of unnecessary clinic reviews. Our results suggest that the current tele-ophthalmology system on trial may reduce the number of patients seen unnecessarily within secondary care, and could potentially reduce waiting times and patient travel times. This modality appears to be highly acceptable to patients and clinicians.

CONCLUSIONS

We envisage tele-ophthalmology will have a significant role in remote areas (highlands/islands), high street optometry practices and also in the GP setting, with non-slit lamp dependant adapters for front and back-of eye imaging (Figure 6). We have commenced follow-up phase 2 Technology Enabled Care (TEC) upscale at the Queen Elizabeth University Hospital, Scotland's busiest ED, where we have joined with the Strathclyde Department of Bioengineering in a collaborative effort to develop retinal and handheld mobile adapters for the purpose of enhanced triage via Video Call. We have also transitioned to *NHS Near Me*, powered by Attend Anywhere, a web-based platform that enables health care providers to provide video call access to their services as part of their 'business as usual', day-to-day operations. Paper surveys have been replaced with webropol, an online survey and questionnaire tool in an effort to maximise questionnaire response numbers.
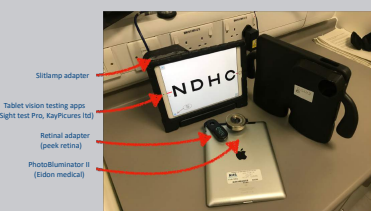**The Forth Valley TeleOphthalmology Paradigm has evidenced significant potential regards improved efficiency, with cost-saving potential directly via saved appointments, and indirectly via reduced travel for patients and NHS staff. Planned steps include a formal health economics evaluation towards a business case for a National roll-out.**

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