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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 as shown in Figure 1. Patients who would previously attend their GP now find A&E as a more attractive option. To manage this steady rise in demand, tele-ophthalmology is currently being utilized 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.

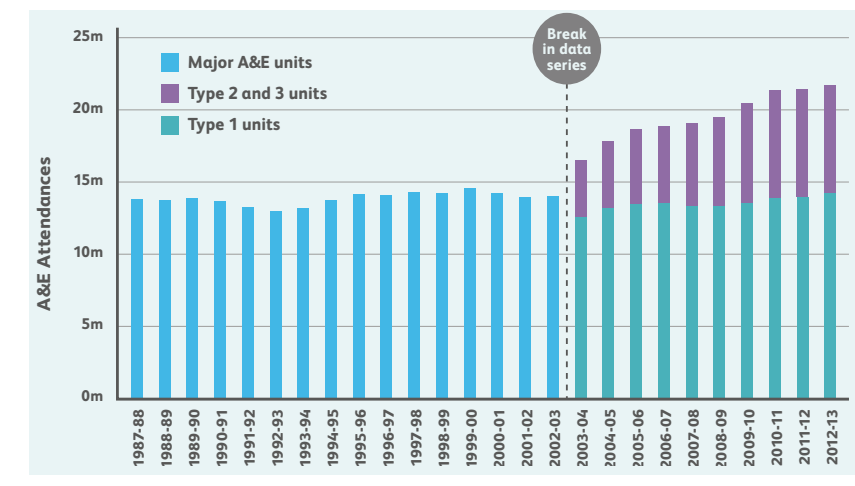
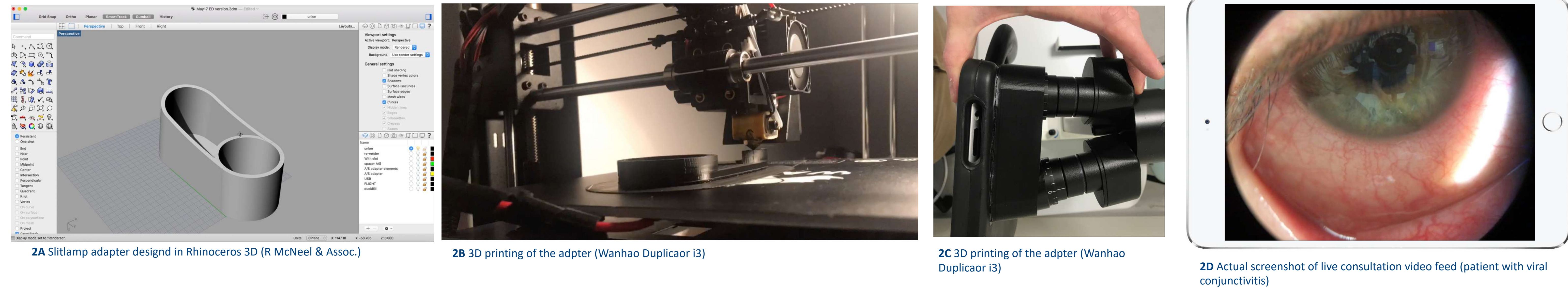


Figure 1: Annual Accident and Emergency Attendances 1987-2013 (source: Kingsfund.org.uk)

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 out-of-hours. 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 view of the patients eye(s).

**Objective: Does Skype-enabled, slitlamp-mounted mobile technology offer an efficient real-time tele-ophthalmology solution?**



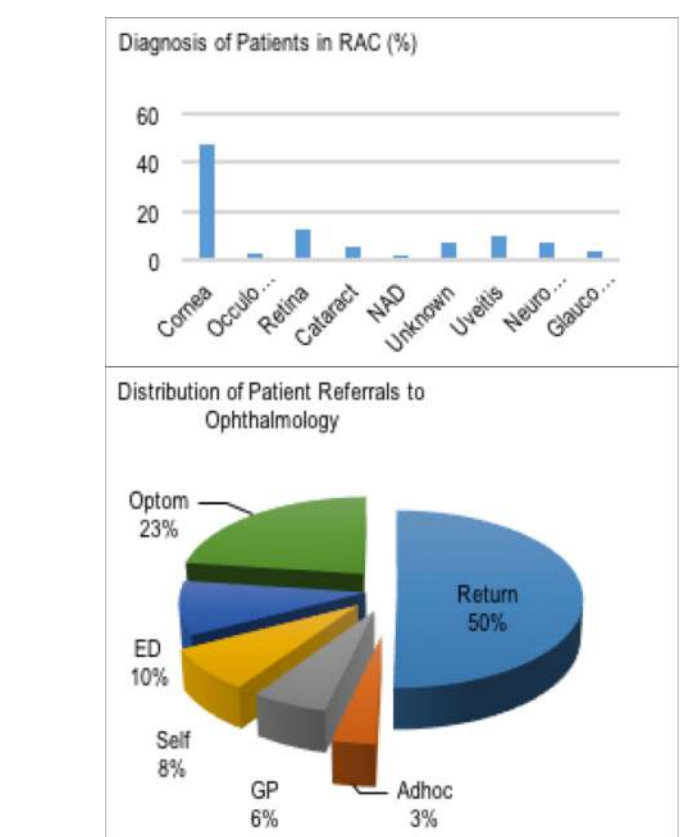
### METHODOLOGY

**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 and 3D printed a slit-lamp adaptor, mounting a tablet device (Apple iPad) to the ED slitlamp, and evaluated Skype for Business to enhance communication between ED/MIU and ophthalmology teams.  
**Phase 3: Trialling the system and evaluating patient and clinician perceptions through use of questionnaires.** These questionnaires include a combination of closed and open-ended questions, Likert scales and semantic differential scales. Three questionnaires were developed (patient, ED physician and Ophthalmologist) and placed at Falkirk Community Hospital, Forth Valley Royal Hospital ED department and Stirling Hospital minor injuries unit. Participation was voluntary with the option to opt out at any point. No patient identifiable information was collected. Questionnaires were completed and placed in a pre-labelled envelope which was subsequently sent to a lone analyst for evaluation.

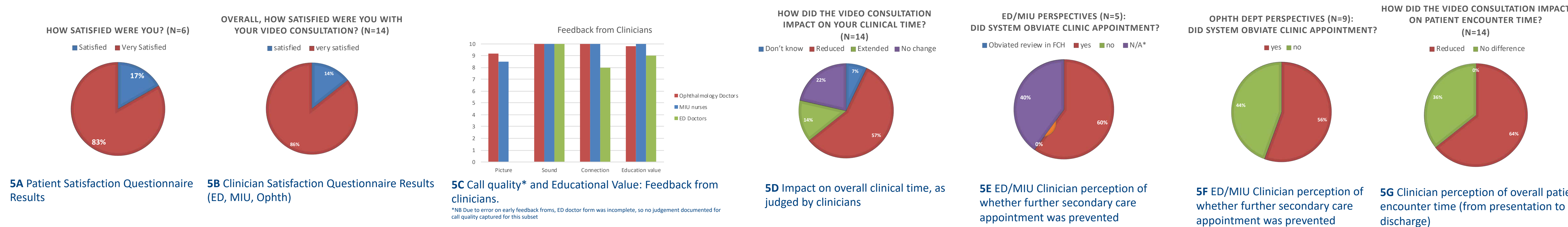


### RESULTS

**Phase 1:** Internal audit demonstrated ~19 patients are seen in the acute eye clinic per day, of which 10% are from the ED. Front-of-eye problems equate to at least 47% (Figure 4). 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.  
**Phase 2:** Trials were initially undertaken with various mobile devices over various internet connections (3G, 4G, Wifi) but a slit lamp on hospital wifi with iPad provided the best combination of equipment for video consultation.  
**Phase 3:** Ongoing. Preliminary results are positive, as patient and physician feedback suggest that the system can reduce consultation time, offer a high level of satisfaction (Figure 5A, 5B) and positive impact regards education value (5C), clinical time (5D), and patient encounter time (5F). Presented data reflects completed forms from 14 clinicians and 6 patients.  
**All clinician respondents (14/14) judged this acute Tele-Ophthalmology modality to positively alter decision making / Follow-up arrangements for acute eye presentations to the Emergency Department or Minor Injuries Unit. All Patient respondents (Figure 5A) and Clinician respondents (Figure 5B) were satisfied with tele-ophthalmology modality as a referral system. >50% 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 reviews in the eye clinic**



4. The makeup of the Rapid Access Clinic (RAC) in Ophthalmology



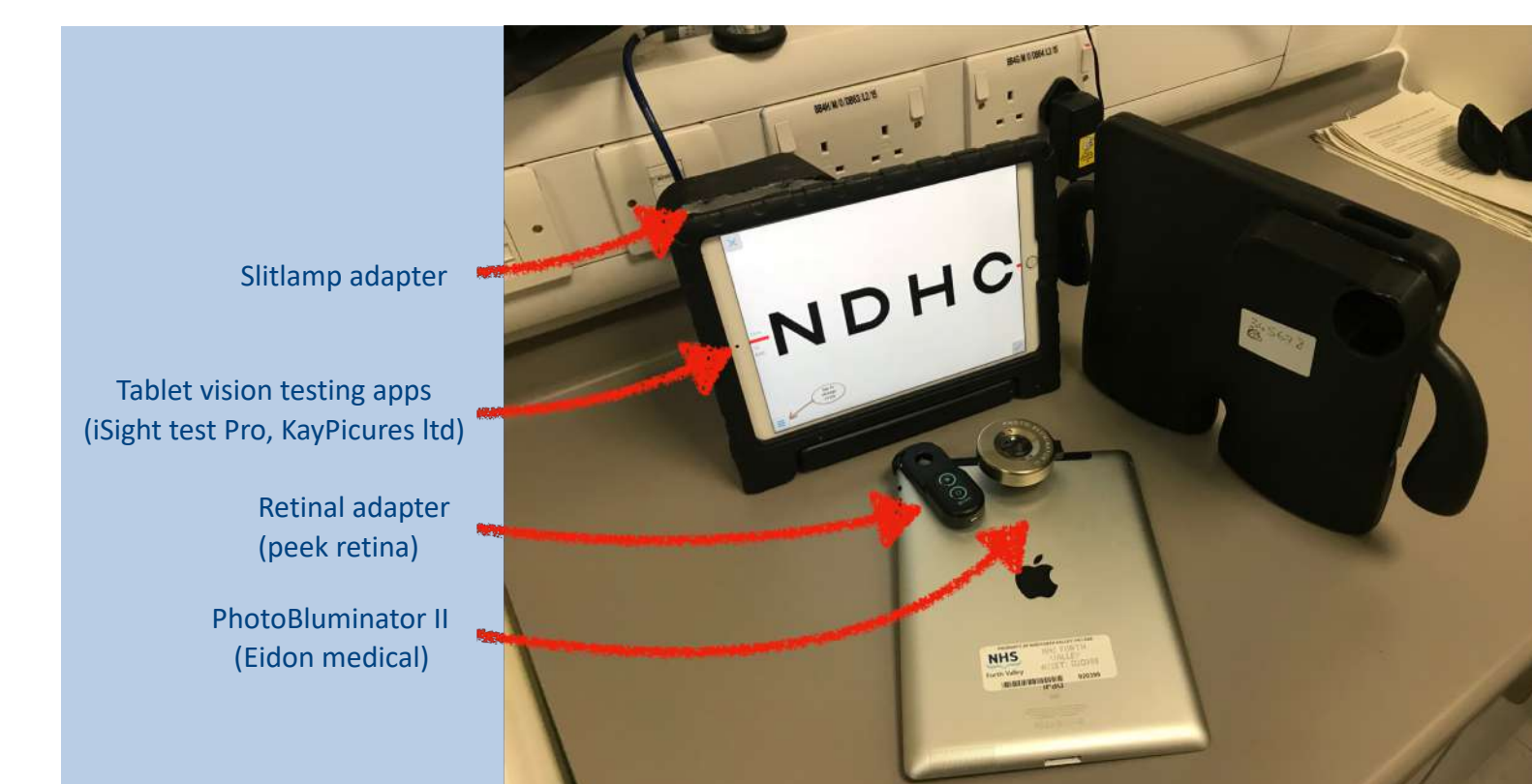
### DISCUSSION

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 screening, 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 screening and management of patients, replacing the present standard of care for referral, a voice phonecall. The average cost to NHS per patient for an outpatient appointment is approximately £150 [estimate from EQPI, NHS FV, May 2018]. The present test of change provides promising results in terms of patient/clinician satisfaction, time-saving and prevention of unnecessary clinic reviews. However, the test period is short, and returned feedback form numbers are small, limiting an accurate cost-saving projection at the present time.

### CONCLUSIONS

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 Forth Valley's annual expenditure without reducing the high level of care currently afforded to its patients. This modality appears to be highly acceptable to patients and clinicians.

We envisage a future where 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). Handheld retinal adapters are gaining traction, with an increasing variety of devices available. Extending the present system to “back of eye” pathologies, as well as broadening the catchment to primary care, presents significant potential for impact in terms of cost-saving and patient convenience.



6. The FV TeleOphthalmology “Eye Pad” Kit