

Impact case study (REF3)

Institution: University of Aberdeen		
Unit of Assessment: 11 (Computer Science and Informatics)		
Title of case study: Promoting innovation in remote and rural healthcare		
Period when the underpinning research was undertaken: 2013-2019		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Ehud Reiter	Professor (Chair) in Computing Science	08/1995-current
Philip Wilson	Director of Centre for Rural Health	08/2012-current
Chris Mellish	Professor in Computing Science	08/2003-10/2015
Alasdair Mort	Research Fellow in Rural Health	01/2010-09/2016
Peter Murchie	Personal Chair (Clinical)	10/1999-current
Judith Masthoff	Professor in Computing Science	11/2004- 05/2020
Period when the claimed impact occurred: 2016-2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words)		
<p>Through the development of several novel digital healthcare innovations, multi-disciplinary research at the University of Aberdeen has introduced new products aiding provision of medical care under conditions where digital connection is limited (e.g. remote areas). This includes the creations of spin-out company, 'MIME Technologies', which now employs 6 people and has secured over GBP500,000 investment since 2019. MIME Technologies released 'Aiber' in 2020, a remote medical device, designed specifically for non-medical professional users and was one of only 10 companies to successfully enter the ATI Boeing Accelerator programme for 2021.</p> <p>Aberdeen research has also underpinned the development of melanoma skin cancer screening application 'ASICA'. Following investment from Cancer Research UK to conduct an initial clinical trial, the app has already led to diagnosis and referral of a patient is now part of an intervention in a 'patient-led surveillance' clinical trial at the University in Sydney, Australia.</p>		
2. Underpinning research (indicative maximum 500 words)		
<p>Rural communities are characterised by their remoteness and low population density, both features are typically associated with limited access to specialist healthcare facilities. The dot.rural Digital Economy Hub based at the University of Aberdeen [P1] (EP/G066051/1, 2009-2015) was funded under the UK Research Councils Digital Economy programme with a focus on user-led application of digital technologies to help enhance the quality of life of remote and rural communities. Interdisciplinary research activities were organised around four societal themes: Healthcare, Accessibility & Mobilities, Conservation of Natural Resources, and Enterprise & Culture. User-partners were key factors in all projects in order to ensure that new developments were inclusive, accessible and engaging.</p> <p>The dot.rural healthcare stream investigated how technology could support patients who lived in areas, which were remote from healthcare providers. In particular, the Managing Information in Medical Emergencies (MIME) project developed technology for emergency medicine, which helped local first responders look after a casualty while waiting for an ambulance. The Achieving Self-directed Integrated Cancer Aftercare (ASICA) project developed technology to help discharged patients (out-patients) with melanoma (skin cancer) monitor their condition and decide whether they need to see a clinician.</p>		

MIME: managing casualties

MIME developed a digital tool [P1; 1], which first responders could use to manage casualties (including diagnosis and time-critical interventions) and also record key data (observations by responder and sensor data such as respiratory rate and blood oxygen levels) which could be handed over to paramedics and clinicians. The MIME team included academic medical researchers (Professor Philip Wilson and Dr Alasdair Mort), computer scientists who specialised in natural language generation (Professors Chris Mellish and Ehud Reiter), clinicians, and paramedics. The team worked with and regularly consulted community first responders and the Scottish Ambulance Service. The underlying computer science research focused on using natural language generation to produce high-quality summaries of the key data [1] and on communicating effectively with first responders who could be highly stressed [2].

When dot.rural ended in 2015, Wilson, Mort, and Reiter continued developing MIME, focusing on extending, refining, and validating the technology. This work was supported by The Digital Health & Care Institute for Scotland (DHI) and Highlands, and Island Enterprise (HIE) [P2]. In turn, this enabled the creation of the spinout company MIME Technologies.

ASICA: integrated patient care

The ASICA project, funded through the dot.rural programme [P1] led to the development of the an app which patients with melanoma skin cancer could use to self-monitor their condition after they were discharged from hospital, and in particular help patients and their care team decide if the patient needed to see a specialist skin clinician because his or her melanoma had recurred [3]. Melanoma can develop into a particularly aggressive type of cancer if not treated early. Unlike many stand-alone commercial health-care apps, ASICA was designed to be integrated into the overall NHS care for the patient. ASICA was developed by a team led by Professor Peter Murchie (Medicine) and Professor Judith Masthoff (Computing Science). From a computing science perspective, the focus was on human-computer interaction (Masthoff's speciality) and ensuring that patients (often elderly, with other health problems and limited familiarity with IT) could effectively use the app. Initially targeted at those living in remote and rural areas, the software sought to provide guidance to out-patients on how to carry out self-examinations and enable them to send images of skin abnormalities directly to specialists.

Upon completion of dot.rural, the work was sustained via funding from Cancer Research UK, through a Population Research Committee project award (C10673/A21685) to conduct an initial clinical trial to assess the effectiveness of ASICA [P3]. The trial was encouraging but it also highlighted some improvements, which needed to be made before ASICA could be deployed by the NHS. Murchie and his team have continued to undertake research on digital support systems, which support cancer patients after discharge from hospital. This has been facilitated by a recent senior clinical research fellowship from the Scottish Chief Scientist Office, assisted by Prof Reiter (Computing Science), which aims to provide a new systems of cancer digital support that will become widely available throughout the NHS (SCAF/18/02 Improving cancer survivorship care through theory-based, tailored eHealth interventions (2019-2024), CSO, NRS, Scottish Universities).

3. References to the research (indicative maximum of six references)

The quality of the research is evidenced by the quality of peer-reviewed research funding from the highly competitive funding sources including UKRI, National Institute for Health Research (NIHR) and Cancer Research UK.

Outputs [1-2] are deemed to be of at least 2* quality and have been published in internationally recognised conferences. Outputs [3-4] are deemed to be of at least 3* quality and have been published in leading, internationally recognised medical journals.

References (citations via Scopus)

[1] Schneider, A., Mort, A., Mellish, C., Reiter, E., Wilson, P. and Vaudry, P.L., 2013, August. MIME-NLG in Pre-hospital Care. In *Proceedings of the 14th European Workshop on Natural Language Generation* (pp. 152-156).

DOI: <http://www.um.edu.mt/events/enlg2013/pdf/ENLG19.pdf>

[2] Kindness, P., Masthoff, J. and Mellish, C., 2017. Designing emotional support messages tailored to stressors. *International Journal of Human-Computer Studies*, 97, pp.1-22.

DOI: <https://doi.org/10.1016/j.ijhcs.2016.07.010>, 7 citations

[3] Murchie, P., Allan, J.L., Brant, W., Dennis, M., Hall, S., Masthoff, J., Walter, F.M. and Johnston, M., 2015. Total skin self-examination at home for people treated for cutaneous melanoma: development and pilot of a digital intervention. *BMJ open*, 5(8).

DOI: <https://doi.org/10.1136/bmjopen-2015-007993>, 12 citations

[4] Murchie P, Masthoff J, et al (2019). Achieving Self-Directed Integrated Cancer Aftercare (ASICA) in melanoma: protocol for a randomised patient-focused pilot trial of delivering the ASICA intervention as a means to earlier detection of recurrent and second primary melanoma. *Trials*, 20(1), p.318.

DOI: <https://doi.org/10.1186/s13063-019-3453-x>, 1 citation

Grants:

[P1] Edwards, P., Mellish, C., Reiter, E., Wilson, P dot.rural Digital Economy Research Hub, EPSRC; 10/2009 – 09/2015; (GBP11,814,897 [EP/G066051/1])

[P2] Wilson, P., Mort, A., Reiter, E. Managing information in medical emergencies, Highlands & islands Enterprise; 04/15-07/16; (GBP22,000)

[P3] Murchie, P. Achieving self-directed integrated cancer aftercare (ASICA) in melanoma: A randomized patient-focused trial delivering the ASICA intervention as a means to earlier detection of recurrent and secondary primary melanoma, Cancer Research UK Population Research Committee project award; 01/2017-06/2020; (GBP156,205). Link: <https://bit.ly/38qBe6g>

4. Details of the impact (indicative maximum 750 words)

The impact claimed in this case study is as follows:

- Creation of a new spin-out company, significant economic investment (over GBP500,000) and job creation supporting rural economic development
- Launch of new product 'Aiber', enabling digital health innovation in various industry sectors, including aviation and maritime.
- Work with NHS partners in North east Scotland and East of England to pilot a low-cost digital solution to facilitate healthcare provision for melanoma screening in the UK
- Development of the ASICA app and support materials, through which at least one at-risk patient has been diagnosed

Providing innovation in healthcare to the aviation sector

In 2016, Mort and colleagues created the spin-out company, 'MIME Technologies' (<https://mimetechologies.com>) in order to commercialise the research [P1, 2]. MIME Technologies is a highly innovative product concept developed over years of end-user testing and focuses on addressing a key gap in healthcare provision in the aviation market (short-haul flights) and maritime market (commercial maritime and superyachts). Long-haul flights usually have a video link service to emergency medical service providers such as MedAire, but this provision is seldom available for short-haul flights. MIME Technologies has filled this gap in the market by offering a solution that enables cabin crew to assess and manage an in-flight medical emergency with remote clinical access to continuous on-scene data, low bandwidth chat functionality and training, which can be adapted to the capabilities and experience of the crew.

In 2016, MIME Technologies undertook a Human Factors trial at the opening weekend of the Six Nations rugby match at BT Murrayfield, in cooperation with the British Red Cross [S1]. The Head of Event Aid and Ambulance Operations outlines the experience, *“British Red Cross looks to incorporate new advances in technology wherever this can support our services. We have a wealth of experience in first aid provision and development, and were delighted to work with MIME Technologies to trial this new innovation in the field.”* [S1]

In 2020, MIME Technologies launched their first CE-marked product, ‘Aiber’ [S2], developed with input from the world’s leading airlines. Backed by a diverse team including an advisor who had a previous role as Head of Health Services for Virgin Atlantic, MIME has raised GBP255,000 in capital to scale its technology [S3], leading to the creation of 6 high-skilled jobs in a rural part of the UK (Highlands), thereby promoting regional economic development with global reach. Aiber is capable of sharing diagnostic-grade cardiac information using state-of-the-art 12-lead electrocardiography with disposable patch technology and has completed field trials with a global aviation company. MIME Technologies was named one of The Business Insider’s ten Scottish digital and science start-ups to watch in 2019, identified for their growth potential. Aiber, as a concept, has received considerable attention from both national and international sources, including BBC News and Low-Fare and Regional Airline News [S4]. In October 2020, MIME Technologies received a highly publicised GBP248,000 in funding from the Scottish Government’s Early Stage Growth Challenge Fund to help alleviate strain on growth companies during recovery from the COVID-19 pandemic [S5].

More recently, MIME Technologies successfully applied to the ATI Boeing Accelerator programme – this is a highly competitive programme and MIME Technologies was selected in 2020 from nearly 200 companies from more than 40 countries – with only 10 places available. The start-ups benefit from a possible GBP100,000 equity investment from Boeing HorizonX Global Ventures and access to ATI, Boeing, GKN Aerospace and Rolls-Royce strategists and technical experts. As part of the programme, mentoring is available from a global network of experienced entrepreneurs, mentors and investors, and introductions will be made to the programme’s network of angel investors, venture capital firms and the wider aerospace industry [S6].

Improving the wellbeing of app users

The ASICA app, developed by Murchie between 2014-2015 for hand-held tablet computers, shows patients how to check their skin, and lets them send photographs to a specialist nurse for assessment [4]. As part of the project, 20 volunteers, 6 GPs and a specialist nurse were involving in testing the app. The volunteers found the app easy to use and, as a result of the checks, two of them were advised to have skin surgery – one of these volunteers discovered they had recurrent melanoma – the app enabled the patient to be diagnosed in good time by an appropriate healthcare provider [S7i, ii]. Based upon the findings of the Experience Laboratory [3], Murchie commissioned two new sets of new videos, which provided instructions on how to perform a skin check. A set of videos were provided for each gender, one for each area of the body (head, neck and face; arms and hands; chest and back; pelvic region; and legs and feet). These videos contained a blend of a live action person describing how to perform the check, with an animated person (with a gender matching the patient’s) showing the procedure [3].

Working with NHS services to provide digital healthcare innovation

In 2016, CRUK awarded Murchie and colleagues funding to undertake a clinical trial using the ASICA app, after finding the project to be, ‘an original and important study for the following up potential recurrence of skin cancer’, which is still ongoing [P3]. The CRUK awarding commended the innovative design and use of patient reported outcome measures, and the plans to move onto a definitive Phase 3 trial [S8i]. Murchie and colleagues are working with NHS Scotland to integrate the app into routine screening for melanoma cancer. A Clinical Nurse specialist in Dermatology, involved in the initial trial stated, *“our collaboration with dot.rural shows that it could be possible to help the NHS relieve pressure from medical consultants and saving valuable specialists’ time by empowering patients through an easy to use, innovative and low cost solution. Currently we are actively engaged in seeking to integrate our application within NHS Scotland.”* [S7]

ASICA: informing patient care in Australia

Following a license agreement in 2015 for the ASICA software, the University of Sydney have undertaken a pilot clinical trial in collaboration with Aberdeen titled, 'Patient-led Surveillance Compared to Clinician-led Surveillance in People Treated for Localised Melanoma' (MEL-SELF) with 100 patients with history of early stage melanoma, sponsored by the National health and Medical Research Council of Australia (GBP13,301; 07/2016-06/2018). ASICA has been delivered as a web-based application (accessible via a browser). Patients received web-based ASICA skin checker log-in [S8ii].

The web-based ASICA skin checker combines instructional videos, guided total skin self-examination and electronic reporting. The team, led by Bell are in the final stages of preparing to open up for a larger RCT with 600 patients. ASICA (in web-based form) will be part of the active run in for that trial, to ensure appropriate participants are randomised into the trial. Intervention participants will also have continued access to the ASICA instructional videos throughout the one year they are in the trial [S8iii].

5. Sources to corroborate the impact (indicative maximum of 10 references)

[S1] 'The Scotsman' online article, outlining MIME Technologies system trial at Murrayfield in 2016 with support from British Red Cross

[S2] MIME Technologies website, details of 'Aiber' produce release

[S3] UK Tech Investment News article, details investment from Equity Gap investors and Scottish Investment Bank (2019)

[S4] Media attention from national news outlets (BBC) and regional airline news (2020)

[S5] Details of investment from Scottish Government, highlighting MIME's Technologies role in supporting economic recovery in aviation industry as a result of the pandemic (2020)

[S6] Details of MIME Technologies placement in BTI Boeing Accelerator programme and resulting economic benefit (2020)

[S7 (group)] (i) Benefits of the ASICA trial, UKRI impact survey (2015); (ii) ASICA final report and testimonial from a Clinical Nurse specialist in Dermatology involved in the trial (2015)

[S8 (group)] (i) Corroborating email statement from CRUK; (ii) corroborating email statement from lead Principal Investigator of MEL-SELF trial; (iii) Clinical trial details (<https://www.anzctr.org.au/Trial/Registration/TrialReview.aspx?id=371865>)