This day, hosted by Professor Jane Burridge, University of Southampton presented contemporary practice in stroke rehabilitation and how technologies might be used to enhance service delivery.

The mixed audience of therapists, other practitioners, researchers and people with stroke were asked to consider how services might be enhanced through technology. The day was divided into two distinct sessions, with the morning being devoted to translation into clinical practice and the afternoon comprising speakers who presented technologies at different stages of development and mainstreaming.

NHS Technology Adoption Centre

The day commenced with a thought provoking presentation from Sally Chisholm of the NHS Technology Adoption Centre. Sally talked about how the NHS must innovate in order to counteract the serious contraction in resources. Radical new solutions that deliver efficiency but also provide sustainability and quality are necessary to manage the difficult financial position. Use of technology has clear potential. Sally gave an overview of references to technology in recent policy, pointing out that the latest Government White Paper (DH, 2010) only refers to technology three times and work is now in progress to address this omission.

The National Technology Adoption Centre was formed at the end of 2007 with a national remit to facilitate the adoption of technologies into practice. They work with organisations, assisting them with the necessary service and system changes and also produce ‘how to’; ‘why to’ guides and implementation road maps for wider knowledge transfer. A report of barriers to technology adoption is available on the Centre’s website. They are working increasingly with the National Institute for Health and Clinical Excellence (NICE) on the assessment of clinical devices and have a widening implementation programme which includes mental health and prevention.
The following case study was provided:

Doppler monitoring provides real time feedback when patients are having major surgery. This technology has been available for over 20 years but uptake has been poor and can significantly reduce risk of complications. Barrier to adoption include training to use this technology and familiarity in practice. NTAC worked with three organisations to implement the technology into clinical practice which included collection of outcome data. Analysis of this data on 12,000 patients demonstrated that use of the technology can reduce length of stay by 3.5 days and limit the use of invasive procedures, thus leading to significant cost savings.

Sally described the characteristics of an innovation culture that is capable of embracing technology, thus:

- Effective engagement with clinicians and other stakeholders to increase confidence and support risk
- Creates challenges to established thinking
- Uses knowledge from national and international best practice
- Creates a common drive to share knowledge and learning
- Reaches agreement on what to measure to create evidence, including data for economic analysis

Sally was questioned about how NTAC work across all the seemingly disjointed NHS organisations involved in this area. She confirmed that industry is frustrated by this and as a consequence, work is beginning to be more joined up. There is a need for a potential list of technologies; this is a current gap. There was a second question about the impact of GP commissioning on stroke care. She confirmed that there was significant interest in community based services.

**Care pathways for upper limb stroke rehabilitation**

The second presentation of the day, which included an interactive session with the audience was from Professor Martin Izermann of the University of Twente, the Netherlands. He is working with Southampton to identify a new care pathway for upper limb stroke rehabilitation. Martin firstly asked the audience to consider how
we integrate patient preferences with clinical evidence. He provided examples of how patients will not accept treatment unless they perceive that they will receive benefit even though experts may prescribe it. He emphasised how patient preferences are extremely important in technology design. Martin then described a statistical method for weighting respondent responses to different scenarios, initially using the familiar example of restaurant preferences to show how the method can be applied to real life situations. This was followed by a clinical example which showed how a decision model which included patient preferences had been created for treatment of dropped foot following stroke.

Volunteer members of the audience from patient, NHS organisation, and practitioner and engineer communities were then asked to participate in an exercise to rate in three scenarios, each involving use of different forms of assistive technology for upper limb stroke rehabilitation. They were asked to rate on the following criteria; clinical benefit, risk of side effects/ adverse events, daily effort from patient, impact for services. The different ratings across the four volunteers generated discussion; for example what is most important and from whose perspective:

- Large clinical benefit versus low risk of side effects?
- Large clinical benefit versus limited daily effort?
- Large clinical benefit versus limited impact of treatment from NHS perspective (resource demands)?
- Low risk of side effects versus limited daily effort?
- Low risk of side effects versus limited impact of treatment?
- Limited daily effort versus limited impact of treatment?

Martin explained how it was possible to change scores based on subsequent stakeholder discussion. Overall weights for each criterion can be calculated; how this can be achieved was illustrated using the example from the interactive session.

Bath Institute for Medical Engineering

Nigel Harris from the Bath Institute for Medical Engineering commenced his session by drawing the audience’s attention to the existence of the European Federation for Research into Rehabilitation http://www.efrr.org and the summer
meeting of the Society for Research into Rehabilitation which will focus upon synthesising evidence. He reminded us that existing patterns of care in older age cannot be sustained; we have to find ways to look after ourselves in old age. Assisted living technologies are the only viable means of meeting demand. However the market is currently limited; acceptability of assistive technologies needs to improve.

The development of Smart1 device was then used as a case example of the challenges that exist in developing a product and bringing it to market (www.themsmartconsortium.org). This prototype device for upper limb stroke rehabilitation is comprised of wireless sensors which are attached to the user’s upper limb. It enables people to undertake prescribed repetitive exercises for rehabilitation of the upper limb following stroke with feedback being provided through a touch screen computer. This is a potentially important development for clinical practice given the inadequate manpower to meet needs for stroke rehabilitation. When the technology was first developed in 2004, wired Xens sensors were used; Nigel went on to describe the collaboration with Philips R&D which led to the incorporation of wireless devices within the prototype which was a significant move forward. The research confirmed that three areas were key to success; being able to attach the sensors successfully to the body, the nature of the feedback and overall usability. The next challenge is how such a device can be integrated into the practice of community stroke rehabilitation teams.

Nigel suggested that the necessary investment to bring such a product to market might be made available through companies involved in gaming products or mobile technology. They are successful and are therefore more likely to have the necessary finance. They are also involved in developing systems that are acceptable and effective in everyday life. A number of contemporary examples of the potential for rehabilitation within readily available technologies were given such as the iPhone, Nintendo Wii, Microsoft Connect and Xbox360 Kinect. Other interesting specialised technology is also available; for example ‘Just Checking’ updates activity data from users moving around their home which is then uploaded onto the website. BIME are currently involved in work to integrate mobile platforms with smart home technology and also to look at the potential of video conferencing for people with dementia.

How technology might be used for rehabilitation is supported in the south west through the ALAN (assisted living action network) http://assistedlivingaction.net/ who have four meetings a year. Nigel emphasised that new members are welcomed.
Rehabilitation of the upper limb

Dr Sara Demain from the University of Southampton then presented the audience with the evidence for technology for stroke rehabilitation. Sara is involved in an NIHR programme grant which is examining how rehabilitation of the upper limb following stroke might be provided through technology. The research involves defining current practice, locating and using the existing research evidence for use of technologies for rehabilitation and from this identifying most promising intervention to take forward into a clinical trial.

Sara made two important introductory points; firstly that traditional stroke rehabilitation is not supported by robust evidence; for example the SIGN clinical guidelines do not provide a recommendation for rehabilitation of the upper limb. Secondly that technology for rehabilitation is not new but even recently developed technologies can be expensive and cumbersome.

She then went on to describe the evidence which had been identified for a variety of devices for stroke rehabilitation. A review of the effectiveness of robots for rehabilitation (Burridge and Hughes) demonstrated that robots are not superior to traditional rehabilitation and are not cost effective. They need to be cheaper, appropriate for use at home and simpler while at the same time providing superior information. Virtual rehabilitation may have significant potential. Commercial VR systems such as the Ninetendo Wii are cheap, socially acceptable and engaging and able to provide feedback on success. However, they have not been designed for users with complexities such those arising from stroke. A third possibility is electrical stimulation, which is recommended for foot drop by NICE but there is insufficient evidence for use with the upper limb. Finally constraint induced movement therapy can have significant effects upon movement in the short term its effects in the long term and upon quality of life are limited.

To date exploration of the potential of technology for stroke rehabilitation has also involved an Interactive exhibition, focus groups with people with stroke, with health care professionals and phone interviews with budget holders. This uncovered very different perceptions on behalf of the the different stakeholder groups. Those people with stroke who attended the exhibition were very self motivated and prepared to self purchase effective technology.

The conclusions she drew for us to consider are that there is a lack of evidence to support use of technologies for stroke rehabilitation but the overall indications are
promising. However therapists can be reluctant to adopt in practice and there is no route to market.

**Lifeguide**

**Professor Lucy Yardley, University of Southampton** then informed the audience of open source systems available on the Internet to assist people to self manage. She is involved in the development of ‘Lifeguide’ which is an open source web based interface ([www.lifeguideonline.org](http://www.lifeguideonline.org)) that enables the easy creation of web pages for a wide range of users which can be tailored; for example CBT sessions are available for smoking cessation. It enables collaboration across other cultures and languages and includes an audio function.

Lifeguide provides tailored advice through the creation of a library of functions for the user. Graphs chart progress of the user over time which can be personalised. Data can be exported to excel. The system can evaluate the length of time the user spends on each page. A number of interventions are in development for different groups including stroke. Lifeguide can have functionality included such as activity monitors or links to mobile phones.

The challenges of developing such a system were illustrated by ‘the Internet doctor’ which can be accessed to assist people with flu systems. This is challenging; for example how much information should be provided? How can webpages be made accessible? The content has been derived from a large body of iterative research with cross section of the population. The developers have learnt to use large font, cartoons and photos to convey information. The Intervention has been piloted with 500 people.

She concluded her presentation by presenting ‘LifeCIT’ to support people to carry out rehabilitation at home following stroke, to be introduced in February 2011. This will involve individuals doing activities around the home while wearing a restraining mitten on their non affected hand. An interface for patients, carers and therapists for using LifeCIT will be accessible through Lifeguide. Users will be encouraged to write down goals with the Canadian Occupation Performance measure then being used to examine achievements. It will also encourage game playing through free games.

**CLAHRC**

The day concluded with **Professor Sue Mawson, from Sheffield Hallam** University talking about her work within the National Institute for Health funded ‘South
Yorkshire Collaboration for Leadership in Applied Health Research and Care (CLAHRC) (http://clahrc-sy.nihr.ac.uk/). She is the only non-medical director of a CLAHRC. This research programme is about bringing evidence into practice, which is particularly important in a region like South Yorkshire which has the highest health inequalities in the country. The CLAHRC model is about developing academies of translational research. She then talked about the most recent work of the SMART Consortium, following on from the previous session from Nigel Harris. The SMART2 project is now taking the self management paradigm into technology, using three demonstrator conditions (stroke, congestive heart failure and chronic pain) and through this exploring the potential for behaviour change through technology. The policy drivers for this were raised including the NHS QIPP agenda which is concerned with saving money while at the same time maintaining quality of care. Sue described the methodology for the SMART2 project which is innovative in that it involves a hybrid of health, social science, design and technology. She illustrated concept development through to paper prototyping of design concepts to iterative development of the prototype. A specific focus was then given to the stroke version of the prototype. A conceptual matrix has been developed which incorporates the theoretical underpinning for stroke rehabilitation, and scenarios identified by people with stroke have been mapped onto this. The technology includes a touch screen computer for use in the home with self management features for stroke, an integrated HTC phone, and it is also planned to include a ‘smart shoe’ to record and relay symmetry and heel strike to the wearer. There will be links to a therapy portal. Sue emphasised the potential value of the device in that it will enable people to help themselves to rehabilitate and self manage. This final year will involve Realistic Evaluation of the prototype – ‘what works for who and in what circumstances’.

**Summary**

The following summary of issues were raised by delegates during morning discussion sessions where they were asked to consider how technologies can be translated into practice and what the criteria are for successful technology:

- The value of co-design with stakeholders combined with strategies for translation into practice and health economic analysis were stressed, as were research collaborations, particularly in the early stages of research. Other important ingredients for success include effective communication, engagement with research funders, market research and stakeholder analysis to determine consumer need, robust research that exploits different
paradigms and implementation strategies and routes to bring products to market.

- There has to be a trade off between complexity and clinical appropriateness. Any device must be functionally useful, personalisable, cognitively meaningful and include treatment theories. Also the size of equipment is an important consideration.

- Middle managers are frequently key to successful implementation in the NHS. Getting the ‘buy in’ of clinicians demands time for adoption alongside a track record of use including how it supports outcomes from the evidence base, enabling the team to own the technology, support with training both with own usage and the education of patients to use it. Any device must be usable with a long shelf life and be applicable to a wide range of patients. Constraints exist due to infection control and manual handling requirements. Medical devices also need to be CE marked.

- For successful adoption, devices need to be motivating and give feedback as well as responding to new trends. They need to be personalisable. It was also stated that engineers need to become more familiar with clinical work and environments and that nursing and therapy students need to learn more about technologies.

The day concluded with Jane reiterating the importance of therapy led research and reiterating Nigel Harris’s invitation to join the ALAN network.