



Chronically Sick and Disabled Persons Act 1970

***Research and Development Work
Relating to Assistive Technology
2003***

Presented pursuant to c.44 1970 Section 22

July 2004

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Introduction

The recently published *NHS Improvement Plan* highlights the commitment of the Department of Health to help people maintain their independence, for example using aids and adaptations to their homes. Assistive technology (AT) offers great potential to maintain the independence of older or disabled people, with encouraging early evidence about its cost-effectiveness.

This report is produced pursuant to Section 22 of the Chronically Sick and Disabled Persons Act 1970. The work has been grouped into categories and outlines a selection of the research and development activity relating to AT funded by the government in 2003.

Full details of all the work funded are available on the Foundation for Assistive Technology (FAST) website (www.fastuk.org), together with information on research funded by other sources. FAST also produce the RAPID Report – Assistive Technology R&D in a rapidly changing world – which describes projects from over 50 researchers across the UK and provides an overview of policy and funding issues. *The NHS Improvement Plan* and other Department of Health publications can be found on the internet at www.dh.gov.uk/publications.

Communication aids

Communication through speech and writing is a complex process which can involve memory, word finding, comprehension, language knowledge and skills, hearing, word forming and projection and upper limb motor skills. Augmentative and Alternative Communication (AAC) is the term for methods of communication which can be used to supplement speech and writing when these are impaired.

Social conversation

AAC that relies on word-by-word generation is very slow, so a phrase-based system is potentially more useful, provided it does not limit what can be talked about. Two systems are attempting to use knowledge of how conversation works in practice to overcome the difficulties inherent in phrase-based systems. These are 'Frametalker' and 'TALK'. Frametalker uses phrases to help users communicate in task-oriented everyday situations such as eating out. TALK also uses pre-stored phrases, but concentrates on social chat rather than specific tasks.

A project funded by the Engineering and Physical Sciences Research Council (EPSRC) and headed by the Department of Psychology, University of Dundee, together with a parallel project in the USA, has combined these two systems to create a flexible communication tool. Enkidu Research, a software company in the USA, has developed an integrated prototype called 'Contact' based on the research.

AAC users trialed the system in real office situations. Enkidu Research has recently merged with Dynavox, and it is anticipated that a commercial product, based on the prototype, will be forthcoming.

Symbol users and the internet

People who use symbols to communicate in addition to, or instead of, text need the World Wide Web to be more accessible. World-Wide Augmentative and Alternative Communication (WWAAC) is a European Union (EU) project which will provide tools and services to develop web browsers and email systems which can translate symbols into multi-lingual text or other symbols, all with speech output via a Concept Coding Framework (CCF) and Writing Support Framework (WSF). Such tools and web-based services will enable people who use one particular symbol language to communicate with others who use a different symbol language.

Swedish	födelsedag	pappa	ge	jag	gåva	hund	liten
Dutch	verjaardag	vader	geven	mij	kado	hond	klein
English	birthday	father	give	me	present	dog	small
PCS							
Picto							
Bliss							

The design is based on a detailed user requirements consultation, conducted by the ACE Centre, Oxford with young people and adults who use AAC and older people with dysphasia. People will be able to connect their AAC devices to a computer and have customised browsers with larger fonts. Images of their favourite sites can be linked directly to their preferred pages within the site using switches and other alternative access devices.

Websites will be translated by special software and read aloud or displayed using symbols and multi-lingual text. Additionally, web authors will be offered special authoring tools to build sites for symbol users, while improvements to web guidelines (WC3 - WAI) will also result from the WWAAC project.

Communication and dementia

With funding from EPSRC, the Universities of Dundee and St Andrews have created a Computer Interactive Reminiscence and Conversation Aid (CIRCA) to enable and support communication between people with dementia and their carers. Collaborating on the project are Alzheimer Scotland – Action On Dementia and Dundee Social Work Department. The aim is to support communication by building on long term memory, which tends to be relatively unaffected by dementia.

The first prototype taken into the field has shown that such a system can facilitate conversation and also give people with dementia more equality of control over the direction of conversation. Interest has been expressed in producing a commercial version of the system. The research team hope to continue their work by developing an interactive system that could supply stimulation and entertainment for people with dementia, which they could use unaided.

Aids for people with a hearing impairment

Communication and hearing impairment

The EU Ortho-logo-paedia (OLP) project is based at the School of Health and Related Research at the University of Sheffield. It aims to provide a computer-based speech therapy programme to improve articulation using a visual presentation of speech production. Researchers collected data from non-hearing impaired people pronouncing certain letters. These vocalisations were plotted on a graph and shown as a coloured circle displayed graphically on a PC. Hard of hearing children were asked to repeat the same letters, and their sounds were shown as a black dot on the screen so they could see how close to the coloured circle their sounds were. This technique is considered to be a potential training tool to improve speech production and work continues until 2005.

Hearing aids and cochlear implants

Increased investment in this area of assistive technology has resulted from the technological revolution of moving from analogue to digital technology. Analogue hearing aids amplify all sounds that can make it difficult to distinguish 'target' sounds from background noise. Digital hearing aids incorporate ways of reducing background sound, which means that users can more easily hear speech in noisy settings. In February 2003 the Government announced an investment of £94 million over the following two years to modernise hearing aid services across England. It is expected that by March 2005 all audiology departments in England will be routinely fitting digital hearing aids.

Most hearing-impaired people can only hear comfortably over a limited range of sound levels. This range depends upon the degree of hearing loss at each frequency. To make sounds audible without being uncomfortably loud, modern hearing aids split the sound into several frequency bands and apply automatic adjustment of volume in each band; this is called 'multi-band compression' (MBC). At the Department of Experimental Psychology, University of Cambridge, a computer program called Camfit was developed by the Auditory Perception Group with support from the Medical Research Council (MRC). This program gives recommended initial settings for MBC based on the audiogram of the patient. The program can be used with hearing aids from many manufacturers and trials show that the recommended settings do help to speed up the fitting process.

A second project being conducted by this group, funded by the MRC with additional support from Defeating Deafness and the Royal National Institute for Deaf People, is concerned with the development and evaluation of procedures for fine-tuning the settings in a hearing aid to suit individual preferences.

A third project has resulted in the development of a test for diagnosing areas in the cochlea where there are no functioning inner ear hair cells and/or neurones. The results of this test help to define what frequencies to amplify within a hearing aid so as to optimise the intelligibility of speech.

Bluetooth technology

Bluetooth is a technology enabling the wireless connection of equipment. Assistive listening devices such as hearing aids and induction loops may incorporate bluetooth technology in the future. The EU is supporting a project to build an assistive listening device called BlueEar which involves creating a Personal Area Network whereby a person with a hearing aid can use a special control unit to switch between receiving signals from, for example, a radio, television or mobile phone. A workshop in the UK evaluated 30 BlueEar prototypes. The next phase will be field trials in the UK, Sweden and the Netherlands.



Video information service

Wireless Information Services for Deaf people On the Move (WISDOM) is a European Commission-funded project involving ten European partners working interactively to deliver access to signed information and communication, including mobile (WLAN/3G) capability. Wireless information services, person to person visual communication, video relay interpreting, and sign language recognition development are some of the results of WISDOM. A website (www.deafstation.org) was launched in October 2003. The site provides a sign language video information service that offers, amongst other items, daily signed news. It is free to use and accessible to anyone with access to the internet. There are plans to continue www.deafstation.org after project funding finishes.

Access for visually impaired people

The EU and the Gatsby Charitable Foundation supported an initiative to increase computer literacy among blind and partially sighted people aged over 35. The initiative identified user needs, designed a training programme, a good practice guide and a website. The partnership involved organisations from five EU countries. The Equal Access to Technology Training (EATT) project is complete and a final report is available.

The EPSRC-funded MultiVis project - Multimodal Visualisation for Blind and Visually Impaired People - is a collaboration between the Departments of Computing Science and Psychology at the University of Glasgow. The aim is to help blind people read graphs, tables, charts and other visually presented information. For example, a graph can be expressed by the sound of musical notes going up and down. Different graphs can be compared using a 3D sound space with the sound from one graph coming from the front, a second from the right, and a third from the left. A raised graph can be printed on a piece of paper so that data can be communicated by touch. Sound can also be added to these tactile diagrams. Sensors attached to the fingertips are connected to a computer that registers where the graph is being

touched. The computer produces musical notes of different length and pitch to describe the slope and distance between two points. The research has also included the use of a special 'haptic' device for 'touching' onscreen information. When using the device, touch feedback gives the impression of feeling the slope of the graph on screen.

EPSRC has recently awarded the Glasgow researchers a further grant to extend the work in partnership with the Royal National College for the Blind. EPSRC funding of over £0.6 million has been committed to the MultiVis project.

eBooks

The Royal National Institute of the Blind (RNIB), City University and partners across the EU have completed a project called MultiReader. EBooks, which can combine visual images, sound and text, are read by means of a PC or handheld computer such as a Personal Digital Assistant (PDA) but are inaccessible to many disabled people. The project aimed to redesign multimedia versions of three books for use by people with visual impairments, hearing impairments or dyslexia. For *Hamlet* by Shakespeare, video and audio clips of different actors doing the same speech were included alongside the text, and people could also create their own index of famous quotes. The eBook *Painting from a New Perspective* was based on a book produced by the RNIB, while the *London Tourist Guide* was written specifically for the project. Throughout the project, the prototype was designed with the help of feedback from users and aimed to maximise usability of the eBooks. Specific accessibility options included real people signing the audio for deaf users, audio descriptions of pictures for blind users, and text highlighting for dyslexic users. Although MultiReader itself has now finished, RNIB will use the results to extend its work on DAISY, the new digital talking book system.

Television

Also funded by EPSRC, the TIWO (Television in Words) project aims to improve text and audio descriptions provided by trained professionals to enhance the appreciation of television programmes for visually impaired people. As part of this project, the AuDesc system is being developed to assist in the preparation of audio description, and to customize audio description for different audiences. The project is also investigating ways in which further value can be gained from audio description by its use with video retrieval and browsing systems. The work is being undertaken by the University of Surrey in partnership with the RNIB, the BBC, the Independent Television Facilities Centre and Softel Ltd.

Computer access for learning disabled people

The RIX Centre was set up at the University of East London to promote awareness of learning disabilities and to ensure multimedia is developed with this in mind. The Big Tree portal aims to create a virtual community where people can share ideas and build research

projects. The site, relaunched in March 2004, has three levels of accessibility where users are directed to the content in which they are particularly interested.

Satellite projects around this 'big tree' focus on accessibility, e-learning and inclusive multimedia production. Access and Participation for eLearning and the World Wide Web (PACCIT APPLE) will be the first 'root' on the tree with its own website. Its aim is to enable people with learning difficulties to make the most of multimedia for eLearning by consulting them to create new products and services. Other partners are the University of East Anglia, City University, XOR and Macromedia. Website development is ongoing with Trans-Active, the Home Farm Trust and Inclusion International.

Learning disabled people have been involved in an EPSRC-funded project led by the University of Nottingham studying the design of input devices for navigating around virtual environments on a computer. The objective was to remove barriers that users experience when using input devices. People with cognitive problems were able to get the most out of using the computer when they could easily see what was happening on screen in response to their actions and the software made it easy to see what to do next. For people with motor difficulties the design of the input device was crucial and the team at Nottingham designed two potential solutions, a modified standard joystick and a two-handed device.

The Portland Partnership works to provide software and hardware for people with learning disabilities. It is funded by the European Social Fund's Equal Initiative until 2005. Building upon the EPSRC work, the teams continue to develop an input device that will help people get the most out of educational multimedia. The end product will be wireless with different physical attachments (such as joysticks or mice) and could be used as an assessment tool. Other partners are Penny & Giles (Traxsys) and the British Computer Society Disability Group.

Housing and assistive technology

In June 2003 a report into disabled people's needs in the residential environment was completed. Funded by the Economic and Social Research Council (ESRC), it highlighted the problems caused by poor design and the failure of building design to consider adequately the needs of disabled people. Building planning and policy have historically failed to take account of basic requirements such as providing minimum space requirements for wheelchairs. This resulted in part M of the building regulations to ensure disabled people's requirements begin to be met.

The ESRC study sought to discover how well the regulations were being adopted. Results suggested that there is a need for greater consultation between stakeholders – designers, builders and users – and that cost estimates should include the cost of not meeting minimum requirements. The regulations encourage a 'medical' reductive approach and fail to consider people's lifestyle choices. For example, a bedroom for a disabled person may only be large enough to accommodate a single bed meaning that the room cannot be shared with a spouse.

Introducing Assistive Technology into Older People's Homes is a collaborative project between Age Concern Institute of Gerontology, the Centre of Rehabilitation Engineering King's College London and the Research Group for Inclusive Environments at the University of Reading. The research has examined feasibility, acceptability, costs and outcomes of introducing a wide range of AT in existing housing occupied by older people.

The research began in October 2000 and was completed in July 2003. It focused specifically on social rented housing in the UK and considered the acceptability of adaptations and assistive technologies to older people. It looked at whether adaptations and AT could substitute for paid care in terms of cost and enhanced quality of life. Findings from the research were that, given careful selection of adaptations and AT, these can enhance quality of life and do so in a cost effective way.

The analyses suggest that the provision of adaptations and AT can be funded through savings in formal care provision and in some cases there will still be overall savings. Although theoretical, the approach used to generate the user profiles, the specification of paid care requirements, adaptations and AT, and the costing of these, were based on information and experiences that are recognisable and acceptable to professionals in the health care, social services and housing sectors.

People with dementia

Gwent Healthcare NHS Trust is undertaking research into AT to support people with dementia. The project will focus on six clients and their carers using call centre technology. The first model Assist Project House for South East Wales was set up in Tredegar to illustrate the capabilities of sensory technology for people with dementia. The property, opened on the 5th September 2003, has been fitted with a full range of sensors and detectors. The majority of these devices were developed by Tunstall Telecom Ltd and are designed to ensure that people with dementia can live as independently as possible. The property offers exhibition space and a meeting room for interested groups. It could also be used as a training facility to raise awareness of the difficulties encountered by people with dementia living in the community.

Design for Dementia: An Evidence Based Approach to Standards in Caring Environments is an EPSRC project renamed Design in Caring Environments to reflect a wider perspective. Loughborough University and the University of Sheffield carried out a quality of life assessment of over 400 residents of care homes and questioned over 700 staff. They created a tool for assessing the quality of the environment called the Sheffield Care Environment Assessment Matrix (SCEAM). Scores for the care homes using this matrix were associated with the quality of life of the people interviewed. Choice and control over the environment appear to associate with psychological wellbeing. This can mean providing people with their own kitchen area or access to a garden. Similarly, engagement with the community was found to relate to increased levels of activity among residents.

A sister project, Configuration and Design in Caring Environments, used data from the care homes to study key aspects of building layout which enhance way finding and quality of life. Reports from both projects are soon to be published.

Mobility

Navigational aids

The Location Based Services (LBS4ALL) project is a collaboration between City University, Kings College London, Ordnance Survey and the RNIB and funded by ESRC, EPSRC and the Department of Trade and Industry. In its initial stage, it aims to provide navigational help for people who have difficulty getting around and need to know the most accessible routes.

A Global Position System (GPS) and smartphone technology will give people visual and text information about, for example, entry points in public buildings, crossings on roads and the 'walkability' of routes. GPS uses satellites to pinpoint location and will be combined with the Ordnance Survey MasterMap, a digital product showing roads and routes. The MasterMap includes an 'Integrated Transport Network' that is being developed to include information on paths and advice on pedestrian routes.

The wearable smartphone will have a web browser that will connect to the Integrated Transport Network. This project aims to ensure that people who have difficulty walking are adequately catered for in the design of national location-based services.

Using stairs

It is estimated that ten per cent of people over 65 cannot use stairs or need help to do so. While electrically powered stairlifts provide a solution, installation is expensive, re-sale is impractical, and users often prefer to struggle. Various stair climbing aids have been designed, but these have failed to provide safety for those with a weak grip, or secure support for descent, or easy installation and removal.

A partnership led by King's College London is receiving funding from the Department of Health to engineer some design concepts that overcome these failures, produce working prototypes, and test them in real life situations with groups of older people. Evaluation will involve users, carers, healthcare professionals and local authority housing providers.

Knee orthoses

Patients with little or no control of the knee joint often use a fixed knee orthosis to assist walking. Because the knee is unable to flex, the leg has to be swayed around or to the side to clear the ground. This increases the effort for the patient and exaggerates the impairment. The Department of Health has awarded a grant to a partnership led by the Orthotic Research & Locomotor Assessment Unit at Oswestry to address this problem.

The project aims to design a prototype knee joint that locks securely during stance phase of gait, but permits knee flexion during swing phase. If successful, this development could benefit people with a wide variety of conditions ranging from polio to traumatic paraplegia.

Robotic aids

Robotics work is very much state of the art. In order to bring together the work of experts and allow knowledge to be applied across all relevant fields, the EPSRC, which has funded over 70 projects in the area, supports the Biologically Inspired Robotics Network (BIRO-NET).

The EPSRC-funded Bio-Robotic Walking Orthosis study has been carried out to assess whether industrialised robotics technologies are mature enough to be used in developing assistive devices for the benefit of disabled people with lower limb impairment. The research has built upon the activities of the EU network on climbing and walking robots (CLAWAR - www.clawar.net) and includes sensing and powering requirements, as well as the mechanical aspects needed to provide a good, easy-to-use user/device interface.

A survey was conducted amongst disabled users to specify their needs, and prototype bio-robotic walking aids were developed and tested by able-bodied people. The project has involved collaboration between the universities of Leeds, Sheffield and Southampton, together with Salisbury District Hospital and the charities Spinal Injuries Association and the Inspire Foundation. It is the intention to build on the recent work with a second phase, which will focus on the detailed requirements and how these can be realised to produce bio-robotic devices for persons with spinal cord injuries.

Access for wheelchair users

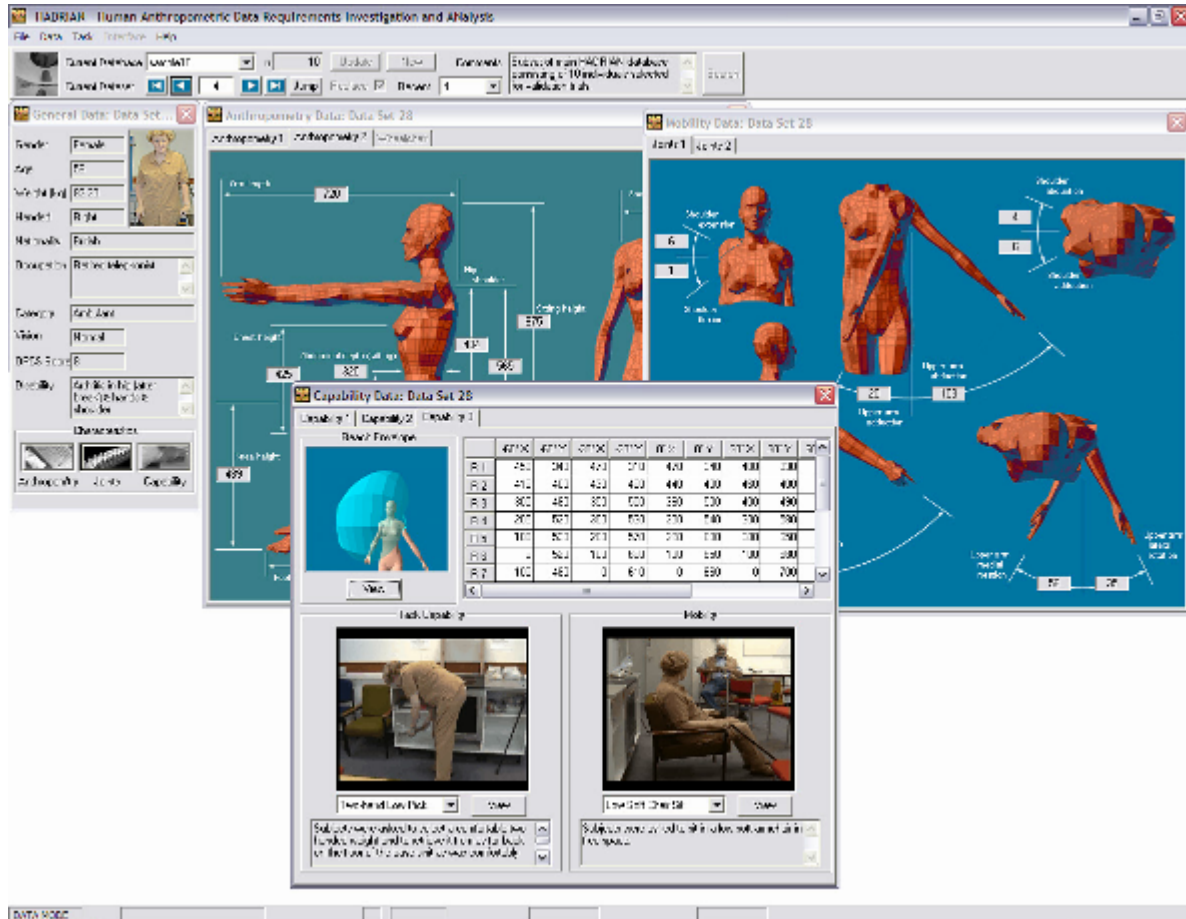
Knowledge Transfer Partnerships (KTP) provide direct support for knowledge transfer by enabling universities to work with businesses using recently qualified people, like graduates, to undertake specific knowledge transfer projects in firms of all sizes. The D'TI has awarded a grant to support a KTP between Loughborough University and Autochair Ltd to research, design and develop a family of electronic 'aids' to assist disabled people with access. Autochair Ltd services the needs of wheelchair users, with a special focus on the disabled driver.

Assessing physical ability to inform design

Designers and human factors specialists use scientific data on human physical abilities to inform the build of a new product. Anthropometrics are used to describe the 'user' or 'target' population for a product. Data is given in terms of the range of body dimensions, such as height, arm length, hand grip and span, which exist in that population so that a designer can specify what range of people a design should fit. Biomechanics considers the operation of the muscles and limbs and the forces upon them. Work in both of these areas is being used to support inclusive design and accessibility. This information also enables users and their advisors to select the most appropriate assistive technologies.

An EPSRC-funded project completed at Loughborough University on the topic of 'design for all' produced a software tool to inform product developers of the extent to which a product accommodates the requirements of older and disabled people. Interviews were used to

understand what is important to people in terms of daily living, and data were collected from 100 people. This included anthropometrics and a range of data from people performing kitchen based tasks, such as putting items on shelves and opening doors.



The result was a database and task analysis tool called HADRIAN - a 'virtual community' of 100 people which stores task data on each person with a picture and some background about him or her. A designer feeds his or her computer based design into the HADRIAN system, selects which 'virtual people' should test the design, and creates a task for them to perform. The task is defined in terms of reach and vision, e.g. look at door handle, turn handle to right. HADRIAN, together with the existing human modelling system SAMMIE, can then get all 100 people to perform the task and will let the designer know what percentage of these people were successful in achieving it. The designer can then find out why some people could not do the task and refine the design accordingly.

Led by the University of Strathclyde Bioengineering Unit an EPSRC project is building the integration of biomechanical and psychological parameters of functional performance of older and disabled adults into a new computer-aided design (CAD) package for inclusive design. The CAD package will sit alongside a database containing data for cognitive function, limb motion, strength and endurance to allow designers to check whether their products are suitable for use by the wider population.

I-Match is a project that includes virtual reality simulations of assistive technologies that can be controlled using different input devices plugged into the PC. The project is funded by the EU and co-ordinated by CREST at Newcastle University. The aim is to measure the abilities of the client and use this data to select possible input devices from a database. It is hoped that this will help a client find the device which best suits them.

Disability Equipment Evaluation Programme

The Medicines and Healthcare products Regulatory Agency (MHRA) manages an evaluation programme on equipment designed to assist elderly and disabled people on behalf of the Department of Health. The programme of work is currently carried out at three Disability Equipment Assessment Centres based within the NHS. The studies are based on both patient trials and technical testing where appropriate.

The results of this work are published by MHRA as a series of evaluation reports. These comparative evaluations are designed to enable purchasers and prescribers of equipment for elderly and disabled people to make informed choices by helping them identify the product(s) which best match(es) the needs of an individual user or of a group of users.

Evaluation work currently in progress covers the following topics:

- Absorbent products for children
- Absorbent products for dribble incontinence
- Communication aids
- Equipment for heavy people
- Memory aids (generic)
- Specialist computer controls
- Standing frames for 8-14 year olds
- Static pressure reducing mattresses
- Static pressure reducing mattress overlays

Information provided from the Foundation for Assistive Technology R&D Database by:

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The report is available on the Department of Health's R&D website:
www.dh.gov.uk/research

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