

# The 4 'A's test for detecting delirium in acute medical patients: a diagnostic accuracy study

Alasdair MJ MacLulich,<sup>1\*</sup> Susan D Shenkin,<sup>1</sup>  
Steve Goodacre,<sup>2</sup> Mary Godfrey,<sup>3</sup> Janet Hanley,<sup>4</sup>  
Antaine Stíobhairt,<sup>1</sup> Elizabeth Lavender,<sup>3</sup> Julia Boyd,<sup>5</sup>  
Jacqueline Stephen,<sup>5,6</sup> Christopher Weir,<sup>5,6</sup>  
Allan MacRaid,<sup>7</sup> Jill Steven,<sup>7</sup> Polly Black,<sup>7</sup>  
Katharina Diernberger,<sup>6,7</sup> Peter Hall,<sup>5</sup> Zoë Tieges,<sup>1</sup>  
Christopher Fox,<sup>8</sup> Atul Anand,<sup>1</sup> John Young,<sup>9</sup>  
Najma Siddiqi<sup>10,11,12</sup> and Alasdair Gray<sup>6,7</sup>

<sup>1</sup>Geriatric Medicine, Division of Health Sciences, University of Edinburgh, Edinburgh, UK

<sup>2</sup>Emergency Medicine, University of Sheffield, Sheffield, UK

<sup>3</sup>Health and Social Care, Leeds Institute of Health Sciences, School of Medicine, Faculty of Medicine and Health, University of Leeds, Leeds, UK

<sup>4</sup>School of Health and Social Care, Edinburgh Napier University, Edinburgh, UK

<sup>5</sup>Edinburgh Clinical Trials Unit, University of Edinburgh, Edinburgh, UK

<sup>6</sup>Usher Institute of Population Health Sciences and Informatics, University of Edinburgh, Edinburgh, UK

<sup>7</sup>Emergency Medicine Research Group (EMERGE), NHS Lothian, Edinburgh, UK

<sup>8</sup>Norwich Medical School, Faculty of Medicine and Health Sciences, University of East Anglia, Norwich, UK

<sup>9</sup>Bradford Institute for Health Research, Bradford Royal Infirmary, Bradford, UK

<sup>10</sup>Psychiatry, University of York, York

<sup>11</sup>Hull York Medical School, York, UK

<sup>12</sup>Bradford District Care NHS Foundation Trust, Bradford, UK

\*Corresponding author [a.maclulich@ed.ac.uk](mailto:a.maclulich@ed.ac.uk)

**Declared competing interests of authors:** none

Published August 2019

DOI: 10.3310/hta23400

## Plain English summary

### **The 4 'A's test: a diagnostic accuracy study**

Health Technology Assessment 2019; Vol. 23: No. 40

DOI: 10.3310/hta23400

NIHR Journals Library [www.journalslibrary.nihr.ac.uk](http://www.journalslibrary.nihr.ac.uk)

## Plain English summary

**D**elirium is the sudden onset of confusion that can happen when someone is unwell. It is common in older people who go into hospital, and it is upsetting for both the patients and their families. Delirium is important to diagnose, because people with delirium do less well than those without, and it is often treatable.

The ideal way to diagnose delirium is with a full assessment by a specialist, but this is expensive and time-consuming. We therefore developed a short test called the 4 'A's Test (4AT). The four 'A's stand for Arousal, Attention, Abbreviated Mental Test – 4, and Acute change.

First, we interviewed hospital staff about delirium and the 4AT. We found that the 4AT was already widely used and that people found it easy to use.

We then tested how the 4AT performed in practice. A total of 785 recently admitted patients aged  $\geq 70$  years participated, of whom around one in eight had delirium. A researcher carried out the full standard delirium assessment on each patient and then a different researcher carried out the 4AT.

A normal 4AT score reliably ruled out delirium. An abnormal score was also reasonably effective in detecting delirium, but staff still needed to follow up such patients with a full assessment. People with higher 4AT scores stayed in hospital longer and were more likely to die, and their treatment was more expensive.

We conclude that the 4AT is a useful test to rule out delirium or to see if more detailed testing is required. It could help treat patients correctly and quickly. This would save money and improve outcomes.



ISSN 1366-5278 (Print)

ISSN 2046-4924 (Online)

Impact factor: 3.819

*Health Technology Assessment* is indexed in MEDLINE, CINAHL, EMBASE, The Cochrane Library and the Clarivate Analytics Science Citation Index.

This journal is a member of and subscribes to the principles of the Committee on Publication Ethics (COPE) ([www.publicationethics.org/](http://www.publicationethics.org/)).

Editorial contact: [journals.library@nhr.ac.uk](mailto:journals.library@nhr.ac.uk)

The full HTA archive is freely available to view online at [www.journalslibrary.nhr.ac.uk/hta](http://www.journalslibrary.nhr.ac.uk/hta). Print-on-demand copies can be purchased from the report pages of the NIHR Journals Library website: [www.journalslibrary.nhr.ac.uk](http://www.journalslibrary.nhr.ac.uk)

## Criteria for inclusion in the *Health Technology Assessment* journal

Reports are published in *Health Technology Assessment* (HTA) if (1) they have resulted from work for the HTA programme, and (2) they are of a sufficiently high scientific quality as assessed by the reviewers and editors.

Reviews in *Health Technology Assessment* are termed 'systematic' when the account of the search appraisal and synthesis methods (to minimise biases and random errors) would, in theory, permit the replication of the review by others.

## HTA programme

The HTA programme, part of the National Institute for Health Research (NIHR), was set up in 1993. It produces high-quality research information on the effectiveness, costs and broader impact of health technologies for those who use, manage and provide care in the NHS. 'Health technologies' are broadly defined as all interventions used to promote health, prevent and treat disease, and improve rehabilitation and long-term care.

The journal is indexed in NHS Evidence via its abstracts included in MEDLINE and its Technology Assessment Reports inform National Institute for Health and Care Excellence (NICE) guidance. HTA research is also an important source of evidence for National Screening Committee (NSC) policy decisions.

For more information about the HTA programme please visit the website: <http://www.nets.nhr.ac.uk/programmes/hta>

## This report

The research reported in this issue of the journal was funded by the HTA programme as project number 11/143/01. The contractual start date was in May 2017. The draft report began editorial review in December 2017 and was accepted for publication in September 2018. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The HTA editors and publisher have tried to ensure the accuracy of the authors' report and would like to thank the reviewers for their constructive comments on the draft document. However, they do not accept liability for damages or losses arising from material published in this report.

This report presents independent research funded by the National Institute for Health Research (NIHR). The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, NETSCC, the HTA programme or the Department of Health and Social Care. If there are verbatim quotations included in this publication the views and opinions expressed by the interviewees are those of the interviewees and do not necessarily reflect those of the authors, those of the NHS, the NIHR, NETSCC, the HTA programme or the Department of Health and Social Care.

© Queen's Printer and Controller of HMSO 2019. This work was produced by MacLulich *et al.* under the terms of a commissioning contract issued by the Secretary of State for Health and Social Care. This issue may be freely reproduced for the purposes of private research and study and extracts (or indeed, the full report) may be included in professional journals provided that suitable acknowledgement is made and the reproduction is not associated with any form of advertising. Applications for commercial reproduction should be addressed to: NIHR Journals Library, National Institute for Health Research, Evaluation, Trials and Studies Coordinating Centre, Alpha House, University of Southampton Science Park, Southampton SO16 7NS, UK.

Published by the NIHR Journals Library ([www.journalslibrary.nhr.ac.uk](http://www.journalslibrary.nhr.ac.uk)), produced by Prepress Projects Ltd, Perth, Scotland ([www.prepress-projects.co.uk](http://www.prepress-projects.co.uk)).

## NIHR Journals Library Editor-in-Chief

**Professor Ken Stein** Professor of Public Health, University of Exeter Medical School, UK

## NIHR Journals Library Editors

**Professor John Powell** Chair of HTA and EME Editorial Board and Editor-in-Chief of HTA and EME journals. Consultant Clinical Adviser, National Institute for Health and Care Excellence (NICE), UK, and Honorary Professor, University of Manchester, and Senior Clinical Researcher and Associate Professor, Nuffield Department of Primary Care Health Sciences, University of Oxford, UK

**Professor Andrée Le May** Chair of NIHR Journals Library Editorial Group (HS&DR, PGfAR, PHR journals) and Editor-in-Chief of HS&DR, PGfAR, PHR journals

**Professor Matthias Beck** Professor of Management, Cork University Business School, Department of Management and Marketing, University College Cork, Ireland

**Dr Tessa Crilly** Director, Crystal Blue Consulting Ltd, UK

**Dr Eugenia Cronin** Senior Scientific Advisor, Wessex Institute, UK

**Dr Peter Davidson** Consultant Advisor, Wessex Institute, University of Southampton, UK

**Ms Tara Lamont** Director, NIHR Dissemination Centre, UK

**Dr Catriona McDaid** Senior Research Fellow, York Trials Unit, Department of Health Sciences, University of York, UK

**Professor William McGuire** Professor of Child Health, Hull York Medical School, University of York, UK

**Professor Geoffrey Meads** Professor of Wellbeing Research, University of Winchester, UK

**Professor John Norrie** Chair in Medical Statistics, University of Edinburgh, UK

**Professor James Raftery** Professor of Health Technology Assessment, Wessex Institute, Faculty of Medicine, University of Southampton, UK

**Dr Rob Riemsma** Reviews Manager, Kleijnen Systematic Reviews Ltd, UK

**Professor Helen Roberts** Professor of Child Health Research, UCL Great Ormond Street Institute of Child Health, UK

**Professor Jonathan Ross** Professor of Sexual Health and HIV, University Hospital Birmingham, UK

**Professor Helen Snooks** Professor of Health Services Research, Institute of Life Science, College of Medicine, Swansea University, UK

**Professor Ken Stein** Professor of Public Health, University of Exeter Medical School, UK

**Professor Jim Thornton** Professor of Obstetrics and Gynaecology, Faculty of Medicine and Health Sciences, University of Nottingham, UK

**Professor Martin Underwood** Warwick Clinical Trials Unit, Warwick Medical School, University of Warwick, UK

Please visit the website for a list of editors: [www.journalslibrary.nihr.ac.uk/about/editors](http://www.journalslibrary.nihr.ac.uk/about/editors)

**Editorial contact:** [journals.library@nihr.ac.uk](mailto:journals.library@nihr.ac.uk)