

## Impact case study (REF3)

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| <b>Institution:</b> University of Nottingham  |  |   |
| <b>Unit of Assessment:</b> UoA4   |  |   |
| <b>Title of case study:</b> Transforming diagnostic assessment of attention deficit hyperactivity disorder (ADHD) in children and young people  |  |   |
| <b>Period when the underpinning research was undertaken:</b> 2014 - 2018  |  |   |
| <b>Details of staff conducting the underpinning research from the submitting unit:</b>  |  |   |
| <b>Name(s):</b><br>1. Dr Charlotte Hall<br>2. Professor Chris Hollis<br>3. Professor Kapil Sayal<br>4. Dr Madeline Groom<br>5. Professor David Daley  | <b>Role(s) (e.g. job title):</b><br>1. Senior Research Fellow<br>2. Professor of Child and Adolescent Psychiatry<br>3. Professor of Child and Adolescent psychiatry<br>4. Associate Professor<br>5. Professor of Psychological Intervention and Behaviour Change | <b>Period(s) employed by submitting HEI:</b><br>1. 2011 to date<br>2. 1996 to date<br>3. 2006 to date<br>4. 2002 to date<br>5. 2010 to date |
| <b>Period when the claimed impact occurred:</b> 2014 - 2020   |  |   |
| <b>Is this case study continued from a case study submitted in 2014?</b> N  |  |   |
| <b>1. Summary of the impact</b><br>Research at the University of Nottingham was instrumental in the national implementation of QbTest, a computerised test used to aid in the diagnosis of ADHD. The AQUA trial provided the first systematic evaluation of QbTest and demonstrated the validity of the test to reduce time needed to make a clinical decision, and enhance clinician confidence and patient care. This independent assessment provided the evidence for the adoption of QbTest by NHS Trusts resulting in 20-30% reduction in clinical time needed to make a diagnosis, and net savings up to GBP93,900 per NHS Trust per year. Providing a scientific evidence base for QbTest has facilitated expansion of its use to new regions including an additional 59 clinics in England, and clinics in the USA and Europe, increasing the number of patients benefitting from the test and increasing revenue by three-fold for Qbtech, the producer of QbTest.   |  |   |
| <b>2. Underpinning research</b><br>Attention deficit hyperactivity disorder (ADHD) is a common disorder, affecting 3-5% of children and is a key risk factor for educational underachievement, and later social and occupational impairment. Over the last 30 years, there has been a 10-fold increase in the number of children being diagnosed with ADHD in the United Kingdom (UK), with annual costs attributable to ADHD costing the National Health Service (NHS) £670 million, placing considerable strain on NHS resources and exposing limitations in existing ADHD diagnostic methods.<br><br>Early diagnosis and timely interventions reduce such risks, yet in the UK the average delay from first clinic visit at a specialist service to diagnosis is 18 months, the worst in Europe. Typically, ADHD assessments combined subjective parent, teacher and self-reports with clinical observations, leading to increased number of consultations and long waiting times. These can act as a barrier to accessing care, contributing to clinical deterioration.<br><br>In <b>2014</b> , University of Nottingham (UoN) researchers led a 20-year follow-up study investigating long-term costs of early childhood behaviour problems, establishing that childhood hyperactivity was associated with a 74% increase in public expenditure costs (to healthcare, social care and criminal justice services) in adulthood. According to National Institute for Health and Care Excellence (NICE) guidelines, confirmed ADHD diagnosis is required for access to treatment, therefore timely and effective diagnosis is crucial to improve access to treatment of ADHD and therefore improve health outcomes <b>[1]</b> .<br><br>To address this issue, UoN researchers explored alternative approaches to improve the care pathway for ADHD, by evaluating objective standardised assessments of ADHD. Their research shows that a computerised diagnostic ADHD test called QbTest, an existing commercially available test developed by QbTech, is highly effective in accelerating and supporting ADHD diagnosis. The test combines a unique package including a computer test |  |   |

of attention and impulsivity with a motion tracker to measure activity, and compares the individual's response against an extensive set of normative performance. This is offered alongside training and support provided by QbTech to help clinical interpretation of the test.

Researchers conducted a systematic review in **2015** of the effectiveness of all computerised ADHD tests, including QbTest, which demonstrated that the use of objective measures aided ADHD differentiation from other diagnoses. Computerised tests that included estimates of impulsivity, attention and activity showed the greatest potential as a clinical tool to aid decision making to confirm or exclude ADHD diagnosis [2].

In **2016**, UoN researchers conducted a pre vs. post-test audit study of confirmed ADHD cases in a UK Child and Adolescent Mental Health services (CAMHS) clinic. Researchers compared diagnostic decisions using QbTest compared to without QbTest, and found that adding QbTest to the ADHD diagnostic process reduced the number of clinician appointments from 3 to 2, and resulted in 20% cost-savings to the service [3].

The University of Nottingham then led on the **first** randomised control trial (RCT) conducted on QbTest, known as the AQUA trial (Assessing QbTest Utility in ADHD), to evaluate the impact of QbTest on the speed and accuracy of ADHD diagnosis. The protocol was published in **2014**, and the trial results later published in **2018** [4]. For 250 young people being assessed for ADHD, researchers compared the number of confirmed positive or negative ADHD diagnoses made by clinicians who were randomly assigned to receive or not receive QbTest results. Adding QbTest to routine assessment resulted in a 26% increase in the number of diagnostic decisions made, a reduction of 15% in the number of consultation minutes required for a decision and improved clinician confidence in decision-making [4].

As part of the AQUA trial, UoN researchers also used cross-sectional surveys and semi-structured interviews to explore experiences of the QbTest in clinicians and families [5]. QbTest was viewed positively by both, with clinicians observing improved clinician-patient communication and families reporting an increased understanding of symptoms.

### 3. References to the research

#### **Publications:**

1. D'Amico, F., Knapp, M., Beecham, J., Sandberg, S., Taylor, E. and **Sayal, K.**, 2014. Use of services and associated costs for young adults with childhood hyperactivity/conduct problems: 20-year follow-up. *British Journal of Psychiatry*, 204(6), pp.441-447. DOI: [10.1192/bjp.bp.113.131367](https://doi.org/10.1192/bjp.bp.113.131367)
2. **Hall, C.**, Valentine, A., **Groom, M.**, Walker, G., **Sayal, K.**, Daley, D. and **Hollis, C.**, 2015. The clinical utility of the continuous performance test and objective measures of activity for diagnosing and monitoring ADHD in children: a systematic review. *European Child & Adolescent Psychiatry*, 25(7), pp.677-699. DOI: [10.1007/s00787-015-0798-x](https://doi.org/10.1007/s00787-015-0798-x)
3. **Hall, C.**, Selby, K., Guo, B., Valentine, A., Walker, G. and **Hollis, C.**, 2016. Innovations in Practice: an objective measure of attention, impulsivity and activity reduces time to confirm attention deficit/hyperactivity disorder diagnosis in children - a completed audit cycle. *Child and Adolescent Mental Health*, 21(3), pp.175-178. DOI: [10.1111/camh.12140](https://doi.org/10.1111/camh.12140)
4. **Hollis, C.**, **Hall, C.**, Guo, B., James, M., Boadu, J., **Groom, M.**, Brown, N., Kaylor-Hughes, C., Moldavsky, M., Valentine, A., Walker, G., **Daley, D.**, **Sayal, K.**, Morriss, R., Curran, S., Clarke, J., Holsgrove, S., Jennings, T., Kulkarni, N., Moldavsky, M., Nathan, D., Skarstam, A., Selby, K., Vijayan, H. and Williams, A., 2018. The impact of a computerised test of attention and activity (QbTest) on diagnostic decision-making in children and young people with suspected attention deficit hyperactivity disorder: single-blind randomised controlled trial. *Journal of Child Psychology and Psychiatry*, 59(12), pp.1298-1308. DOI: [10.1111/jcpp.12921](https://doi.org/10.1111/jcpp.12921)
5. **Hall, C.**, Valentine, A., Walker, G., Ball, H., Cogger, H., **Daley, D.**, **Groom, M.**, **Sayal, K.** and **Hollis, C.**, 2017. Study of user experience of an objective test

(QbTest) to aid ADHD assessment and medication management: a multi-methods approach. *BMC Psychiatry*, 17(1). DOI: [10.1186/s12888-017-1222-5](https://doi.org/10.1186/s12888-017-1222-5)

#### **Details of grant awarded:**

Funding for the AQUA Trial was awarded to the University of Nottingham and funded by: National Institute of Health Research (NIHR) Collaboration for Leadership in Applied Health Research and Care (CLAHRC) 2014 - 2017: £250,000. The research was supported by the NIHR MindTech Healthcare Technology Co-operative (£250,000) [Lead Applicant – Dr Hollis].

#### **4. Details of the impact**

##### **Adoption of the QbTest across England**

In **2017**, Professor Hollis and Dr Hall presented the **2014** protocol AQUA trial and preliminary AQUA trial results to the East Midlands Academic Health Science Network (AHSN), a network who drive the adoption of innovative technologies in the NHS **[4]**. The AHSN then supported the implementation of QbTest within 3 Trusts in the East Midlands (Lincolnshire, Leicestershire and Nottinghamshire) **[A]**. This resulted in all 3 Trusts signing contracts for ongoing provision of QbTest **[A, page 23]**. In an independent evaluation conducted by the AHSN in **2017**, the adoption of QbTest showed a reduction between 20-30% across the 3 Trusts in clinical time required for a diagnostic decision **[A, page 23]**.

In **2018**, findings from the AQUA trial led to the Strategic Clinical Network for Greater Manchester, Lancashire & South Cumbria recommending QbTest for ADHD diagnosis, which subsequently led to the uptake of QbTest across 10 additional boroughs in Greater Manchester **[B]**. Since the start of the AQUA study in **2016**, the number of clinics using QbTest has increased in England from 27 to 86 clinics **[C]**.

In **2018**, the effectiveness of QbTest in ADHD diagnosis was recognised and included on the AHSN 'Atlas of Solutions', an online resource which showcases the best examples of innovative technologies across the healthcare system **[D]**. The process of including technologies on the Atlas of Solutions is highly rigorous, with evidence reviewed by panellists from all 15 AHSNs across England. Evidence from the AQUA trial was pivotal in underpinning the successful adoption of QbTest onto this list **[E]**.

Subsequently, QbTest was accepted as a National AHSN Programme that started in **April 2020** to be implemented across England. Each AHSN is resourced to encourage adoption of QbTest within child clinics across England, with an adoption target of 70% of clinics in England by the end of 2022 **[E]**. Since the national adoption in **April 2020**, 8 new clinics have commenced QbTesting and a further 38 are projected to the end of April 2021 **[E]**. The objective of the National Focus ADHD Programme is to place QbTest in an additional 129 clinics by April 2023.

##### **Cost savings to the NHS**

The East Midlands Trusts AHSN evaluation conducted during **2017** demonstrated that using QbTest for ADHD diagnosis resulted in efficiency savings averaging 32.60% - **up to GBP93,900 per NHS Trust annually**, achieved through reduced appointments required for diagnosis and quicker throughput of patients **[A, page 12]**. Time to diagnosis reduced by 5 months on average (153 days), reducing the overall time to decision to between 2 weeks - 8.50 months, compared to the previous length of between 5 - 15 months **[A, page 12]**. Further cost benefit analysis conducted by the AHSN demonstrated once QbTest is implemented across England, a positive NHS benefit-cost ratio of GBP4.20 for every GBP1 invested will be realised over a 4 year period **[F, page 30]**.

##### **Growth of Qbtech**

Qbtech (<https://www.qbtech.com/#>) is a Swedish company, formed in 2002 and the commercial producer of QbTest. Qbtech first formed a relationship with UoN researchers in 2012 in an introductory meeting, where it was discussed how an efficacy trial of the QbTest could fit into the research priorities of UoN research. The director of Qbtech stated that the AQUA trial was **pivotal** for defining the evidence base for QbTest and subsequent growth of

QbTech [C]. *“The AQUA trial marked a step-change for Qbtech in the UK as it provided independent evidence about the clinical and health economic value of QbTest, our main product. The fact that Qbtech was open to such a test of our product within the context of an RCT run by a highly respected research team bolstered the credibility of QbTest from the start of the study.”*

Following the announcement of the AQUA trial protocol in **2014** and the subsequent results in **2018** [4], Qbtech collaborated with UoN researchers to establish coherent communication messages about the study and included slides on AQUA within all their sales pitches and training presentations for staff. Qbtech also used social media, primarily LinkedIn, to share communications from the AQUA communications team. [C]. Between **2016-2020**, Qbtech revenues **trebled** and their customer base increased by 59 clinics in England, therefore benefitting more patients.

The AQUA study findings facilitated the growth of Qbtech in the UK and the United States of America (USA) primarily, countries that together contribute two thirds of the company's revenue. Since **April 2018**, Qbtech have recruited 10 new members of staff (headcount: 10) to support their international business expansion and intend to recruit a further 15 people (headcount: 15) by the end of 2022. [C].

Findings from the AQUA trial supported Qbtech in winning the prestigious Health Service Journal (HSJ) Award “Innovation in Mental Health” for Qbtech in **2018**, in which the panellists specifically noted the research evidence [4] of reduction in waiting times and improved effectiveness of care as key attributes [G].

#### **Practitioner, patient and family benefits of using QbTest**

The evidence based created by the AQUA trial was critical in the creation of a comprehensive business case for the widespread adoption of QbTest across NHS Trusts in England. In **2019**, a survey was conducted with NHS staff at 11 Trusts who use QbTest, and all respondents reported that the UoN evidence base for QbTest was crucial in their decision to implement the test [H, page 5]. In 7 of the 11 NHS Trusts, they reported using QbTest once research evidence from the AQUA trial was made publicly available [H, page 6]. Implementing QbTest has increased clinicians confidence in making a diagnosis. For example, one healthcare professional said *“I would move to the diagnosis more confidently and more quickly having evidence that something was wrong, you know objective evidence...reduced the amount of the anxiety of uncertainty”* [I].

From **2013** to **2019**, the number of patients benefiting annually from QbTest has more than **doubled**, increasing from 32,000 to 77,000 per year, but in the UK the increase is more than **five-fold**, from 3,000 to 17,000 per year [C].

Clinicians reported better communication with families, reduced time to diagnosis and quicker transfers to appropriate pathways if ADHD was ruled out [H, page 12]. A consultant Paediatrician at United Lincolnshire Hospitals and Clinical Lead for the project said *“As a clinician with extensive experience in assessment, diagnosis and treatment of ADHD, I can honestly say that the addition of QbTesting has revolutionised my clinical practice. The feedback from clinicians, parents and schools so far has all been extremely positive. We are already planning how we can extend the use of QbTests into other areas.”* [G].

The ADHD Foundation, a national charity, now endorses the QbTest for improving the care pathway for families, following the results of the AQUA trial [J]. The Chief Executive of the charity said *“The evidence from the AQUA-Trial enables us to confidently endorse QbTest as a clinical tool to aid assessment. We are able to use this evidence to show our stakeholders that incorporating QbTest into ADHD assessment may reduce time to make a diagnostic decision and thus facilitate better service provision for children, young people and their families.”* [J].

Families view the test positively, as one parent said *"As a parent of a child with ADHD I know how difficult it is to get an ADHD diagnosis. I have heard so many positive stories from families who have had the QbTest as part of their diagnostic assessment. I also have friends who's children have benefitted. The findings of the AQUA-Trial gives me more confidence that when doctors are using the QbTest we are getting the best service available as every child deserves the same tests and treatment"* [K].

#### **5. Sources to corroborate the impact**

[A] East Midlands AHSN. Transforming ADHD Care Across the East Midlands: An Evaluation Report, 2018.

[B] Testimonial from Consultant Child and Adolescent Psychiatrist, Manchester (Pennine Care NHS Foundation Trust), January 2021.

[C] Testimonial from the Managing Director of Qbtech, November 2020.

[D] AHSN Atlas of Solutions: <http://www.ahsnnetwork.com/new-innovation-case-studies-published-atlas/>

[E] Testimonial from Head of Innovation Programme Delivery, East Midlands AHSN, November 2019.

[F] Kent Surrey Sussex (KSS) AHSN, Cost-benefit analysis for QbTest for ADHD.

[G] Press release from the East Midlands AHSN 'East Midlands Academic Health Science Network and partners win national HSJ award for transforming ADHD care', November 2018.

[H] AHSN and UoN evaluation of impact of the AQUA Study on the use and implementation of QbTest in clinical practice, July 2019.

[I] East Midlands AHSN ADHD Care in the East Midlands, Briefing document, 2018.

[J] Testimonial from CEO of the ADHD Foundation, February 2020.

[K] Email from parent of a child who has ADHD, talking about QbTest, November 2018