



Children's Hospital Alliance
A Partnership for Child Health

Was Not Brought Artificial Intelligence Tool:

Findings from the Evaluation

July 2023

The logo for Children's Hospital Alliance, featuring a white dashed circle on a background of a smiling child's face.

Children's
Hospital
Alliance

The challenge that our patients are facing



- Every year in the NHS, more than 1.2m children are not brought to their hospital appointments. Across the CHA, that is around 110,000 patients.
- There are many reasons: parents may decide the appointment is not needed, or simply forget
- But many of our most vulnerable patients miss their appointments because their parents/carers cannot access healthcare. Common issues include
 - parents not understanding the need for the appointment, e.g. because of language barriers;
 - parents having other childcare responsibilities;
 - parents not being able to afford transport to hospital / time off work;
 - the child or the adult having mental health problems or autism.
- The most deprived children are twice as likely not to be brought for their appointment as the least deprived. And missing appointments is one of the top 10 indicators of avoidable child death.



The Children's Hospital Alliance is tackling this for patients



- The Children's Hospital Alliance brings together 13 of the biggest paediatric hospitals across England and Wales
- In 2021 the CHA decided to use innovation to support patients in reducing Was Not Brought rates
- Alder Hey Innovation developed an Artificial Intelligence tool which uses data to identify children most at risk of missing their appointments
- The then-10 Trusts of the CHA allocated £1m of a national Accelerator funding grant to
 - Refine the tool, roll it out and deploy it across 9 Trusts
 - Put in place 10 pilot programmes to support the most vulnerable patients and reduce WNB rates.



Summary of key findings

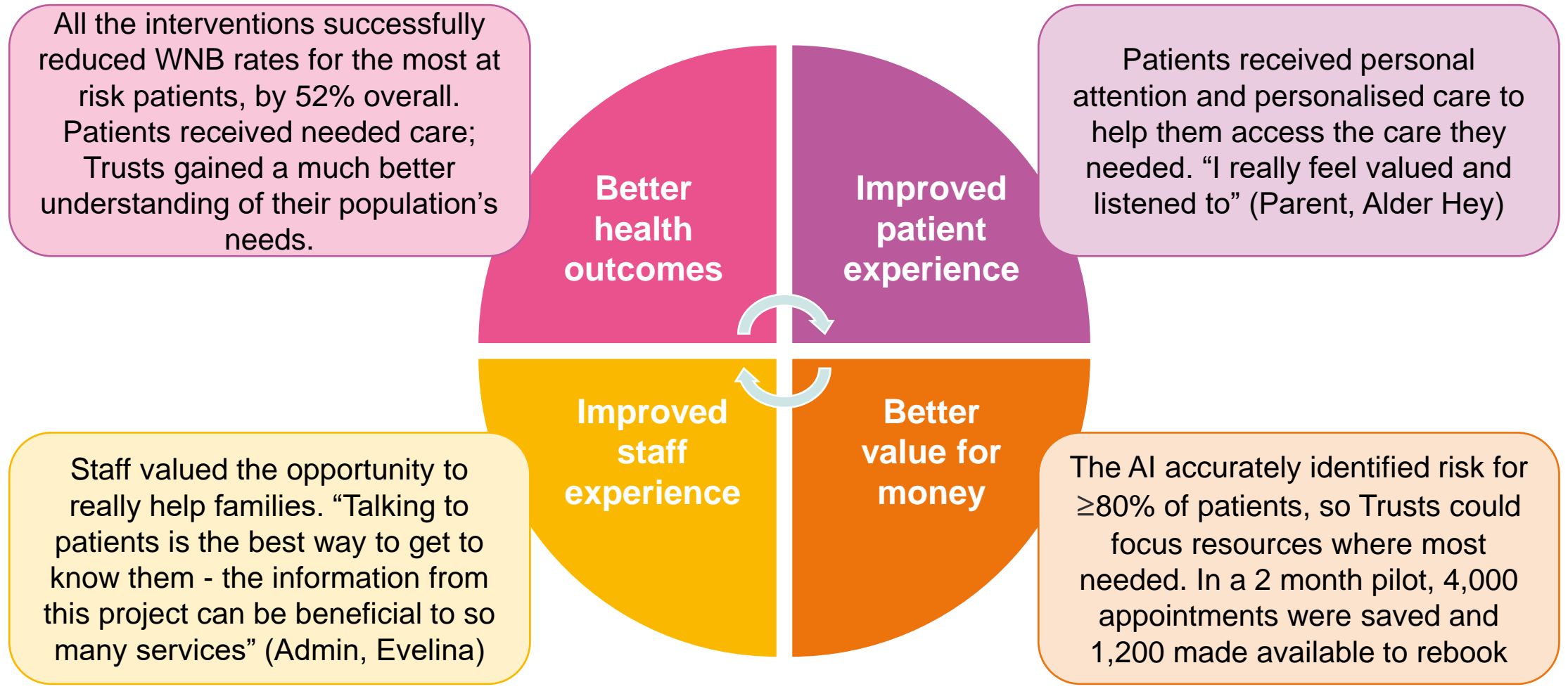
The AI tool identified patients at risk to at least an 80% level of accuracy

Amongst the most high risk patients (c.70-80% likelihood of not attending) there was a 52% reduction in WNB levels

All Trusts (except Manchester) were able to roll out the AI and use it to inform the pilots; the biggest challenges were data quality and BI capacity

All of the interventions were effective in reducing WNB. The most effective were those personalised to the patient and involving clinicians.

Meeting the NHS's top strategic aims



Overview of the programme



The AI tool

Data processing agreement signed between each Trust and Alder Hey

Each Trust regularly uploads 46 pieces of anonymised data about patients booked for OP appointments

AI algorithm identifies the children who are most at risk of missing their appointments,

Data returned to Trusts who can then focus support on those children most at risk

Interventions for CYP most at risk of not being brought

Trusts divided into clusters to trial different interventions. Focused on CYP most at risk

Each pilot was run for 2 months. Challenges around timing of funding, level of support available

Results identified and evaluated

Trusts are currently at various stages of continuing pilots / continuing with AI tool

The AI tool

What we did, key findings and feedback

What we did: the AI tool



Development of the AI tool

In 2018-21 Alder Hey Innovation worked with clinicians to identify datapoints which predict a child's risk of WNB. They used a design thinking and data validation process to develop an algorithm capable of predicting risk of WNB. This was built into an AI tool.

Data processing agreement signed

In 2021 AH offered the AI tool to the CHA for trialling across 9 Trusts. CIOs worked together to develop a standard data processing agreement and Data Protection Impact Assessment which each Trust signed. BI leads worked together to refine the data requirements for Trusts.

Trust uploads data

The algorithm uses 46 datapoints to predict risk of WNB. Each Trust cleaned and anonymised their data and uploaded it manually; the aim is to draw data automatically from Trusts' data warehouse. At first historical data was used to train the system; ultimately live data was used.

AI algorithm identifies children at risk

The algorithm reviews the anonymised data and produces a risk score for each child. Initially this process took 12 hours; it is now almost instantaneous. The process is automated and although Alder Hey host it they never see the data.

Data returned to Trusts

Once Trusts receive the list they can de-anonymise it and use it to identify which children are at greatest risk of not attending. A specific intervention is applied to support these patients.

Findings on the AI tool



Accuracy of the tool

- Algorithm looked at historical data to compare predictions of WNB rate against actual attendance
- **achieved $\geq 80\%$ degree of accuracy** in predicting WNB rates for all Trusts

Usability

- Setup process was challenging for all Trusts –first iterations of the tool were less intuitive but this was improved in multiple iterations
- Initially turnaround was 24 hours to get results. This was improved over multiple iterations to simplify the process and reduce turnaround for results to 2 hours.

Rollout

- The AI tool depended entirely on the quality of data that was uploaded to it
- Some Trusts struggled to prepare and clean the data to the necessary standard
- This necessitated a huge amount of support and input from the Alder Hey business team that would not be sustainable at larger scale

Qualitative feedback on the AI tool



“It was a challenge balancing workload with submission schedule”

“A lot of resource needed to get the algorithm working for our Trust”

“Data feed was quite intricate to set up”

“Very impressed once it was fully up & running, getting to that stage was fraught & lengthy”

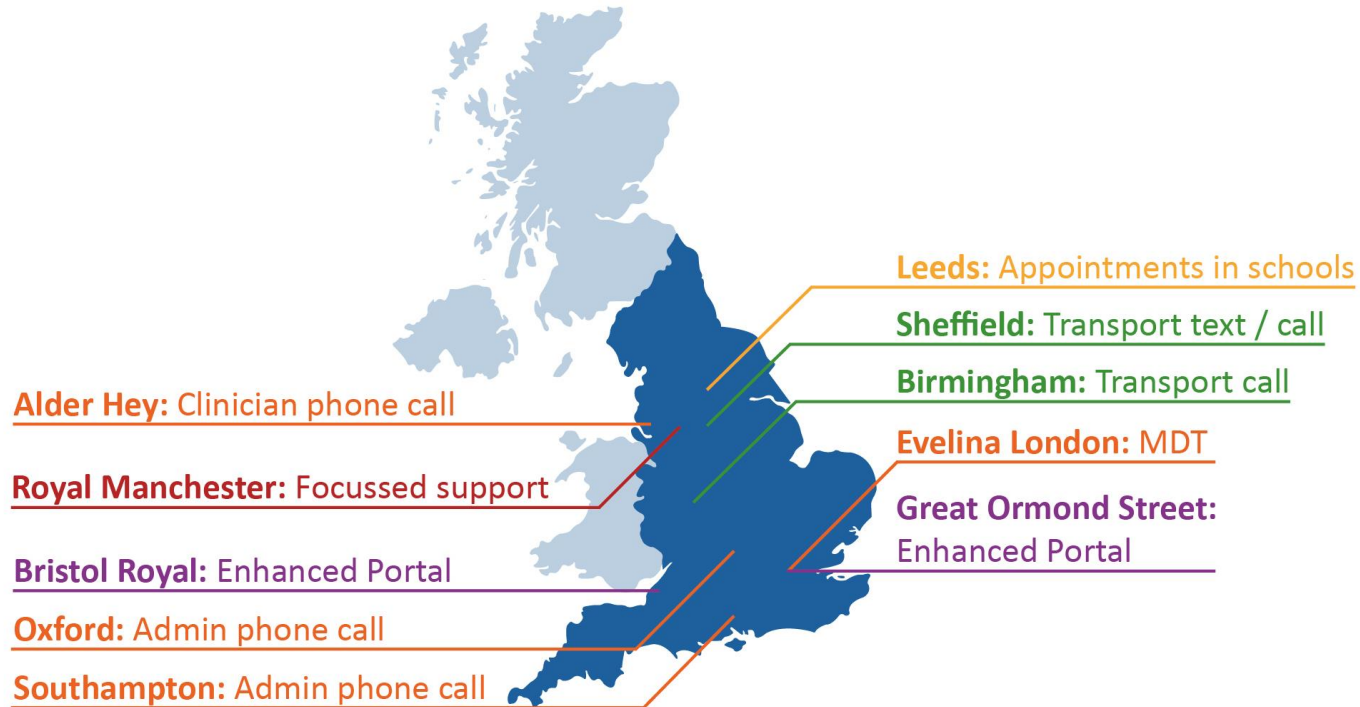
“Archaic data systems at our Trust”

“Steep learning curve- hadn't worked on a project of this scale before”

The WNB interventions

What we did, key findings and feedback

What we did: the interventions



Findings on the WNB interventions



Linking to the tool

Level of WNB rates prior to the pilot

Overall reduction in WNB rates

- **All Trusts** except for Manchester (which was rolling out its EPR and could not deploy the AI tool) were able to use the AI tool to identify which patients to target
- Average WNB rate in paediatric Trusts, without the interventions, ranges from 6.7% to 11%
- Most Trusts focussed on cohorts of patients who were identified by the tool as having a 70-80% risk of non-attendance
- Prior to the pilots these patients had a WNB rate of **68%***
- On average, Trusts saw WNB rates amongst the targeted patients fall from 68% to **16%: a reduction in WNB rates of around 52% amongst the most at risk groups.** 4,000 WNBs were prevented in 2 months.
- A further **17% cancelled in advance** so that there was an opportunity for the Trust to reallocate that appointment: 1,200 appointments in 2 months

*Based on estimates of the performance of the algorithm from Alder Hey training data.

Impact of the interventions by Trust



The pilots ran for 2 months with differing levels of staffing and resources

We would expect even greater impact from longer, more established programmes

Transport call:
BWC: 7% WNB
Sheffield: 37% WNB

Appointments in schools:
Leeds: 12% WNB rate

Patient portals:
Bristol: 13% WNB rate
GOSH: 24% WNB rate

Call – led by admin:
Southampton: 17% WNB rate
Oxford: 23% WNB rate

Call – led by clinician
Alder Hey: 36% WNB rate

Call: led by admin and MDT
Evelina: 10% WNB rate

Focus on ASD / LD patients - Calls & improvements to environment:
Manchester: 49% WNB rate

Qualitative feedback from the interventions



“Mum receives benefits ...Mum is willing to spend £90 to travel into GOSH. Staff informed her of fares reimbursement” (GOSH – Portal)

“It was convenient, no travel time for us, less disruption and the appointment was on time so no waiting - Brilliant service” (Leeds - schools)

“I really feel valued with a Clinician making the call and listened to” (Alder Hey – clinician call)

“Lack of parking, now gets taxi but struggles with costs. Would appreciate support with travel costs” (BWC – Transport)

“Our [autistic] child loves the new clean and hygienic environments” (Manchester – ASD/LD)

“Talking to patients is the best way to get to know them - the information from this project can be beneficial to so many services” (Evelina – admin call)

Cost-benefit analysis

Investment into development of the AI tool

Alder Hey Innovation
invested up front in the
development of the AI

The CHA invested £750k
into supporting the rollout of
the AI tool across 10 Trusts

- Investment in kind came from partnership with Microsoft Azure, and clinician time given gratis
- This included buying the licences for all Trusts to use the software Microsoft Azure, which was used to update the data, and BI and programme support to implement the tool
- Cost-savings benefits are derived from the reductions in WNB rates from the interventions
- Beyond this there was a great benefit to Trusts from understanding and being able to more closely map the needs of their patient population

Cost-effectiveness of the interventions



Cost benefits

- The table shows the potential cost saving benefits for every £1 invested, projected over a year. This assumes that the savings from each OP appointment are £120 (based on a blend of first and follow-up appointment costs) and that the volume of patients given the intervention continues at the same level as during the pilot.
- This is an illustration based on assumptions collected during the pilot phases.
- The cost benefits take account of the success rate so any challenges with the data etc will be reflected here (see slide 18 for more details on limitations and assumptions made).

Intervention offered	Estimated benefits after 1 year	Estimated costs after 1 year	CBR £ saved per £ invested
Transport call (BWC)	£686,423	£123,248	£5.57
Transport Additional Text (Sheffield)	£248,472	£49,011	£5.07
Admin Telephone Call (Southampton + Bristol)	£179,640	£79,000	£2.27
Portal (GOSH + Bristol)	£217,440	£149,000	£1.46
Clinician call (Alder Hey)	£104,539	£79,000	£1.32
Admin and Clinician MDT (Evelina)	£86,746	£149,000	£0.58
Focussed support for autism and LD (Manchester)	£10,445	£79,000	£0.13
Schools (Leeds)	£5,875	£79,000	£0.07

Cost-effectiveness of the interventions



Limitations of analysis:

- The benefits of the pilots tend to increase as pilots become more established and more patients attended (see BWC) so we would anticipate higher benefits in practice
- Each Trust received £75k from the CHA, but some Trusts were not able to use the funding within the financial year, so pilots were run with differing levels of resource and different durations.
- **As such the results are indicative rather than definitive**

Data limitations:

- The exact duration of each pilot was not collected, so it was estimated based on the opinion of project managers that pilots went on for a duration of between 1.5 and 6 months. This assumption impacts the estimate of the monthly volume of patients being given an intervention if the pilot went on for a year, which can lead to over- or under- estimates of the benefits of each the intervention based on the accuracy of this assumption.
- Only data on patients identified by the WNB tool and assigned an intervention during the pilots was available. Therefore, it was assumed that the estimate of a WNB rate of 68% in patients identified by the WNB tool *but not given an intervention* from Alder Hey would have been the same baseline at all Trusts. If the WNB tool worked less well at other Trusts or Trusts used different thresholds, this could lead to over-estimating the benefits of the intervention.
- Of the patients who cancelled their appointment after an intervention, 50% of cancelled appointments were assumed to be re-used, with a WNB rate of 7%.
- Costs were estimated based on expected yearly costs to continue pilots into the future. The breakdown of fixed (e.g. initial investment in tech and change management at each Trust) and variable costs (e.g. ongoing staffing costs) was not available, so assumed to be roughly 50:50.
- All variable costs for the intervention (estimated at £35 for an investment of £75k per Trust) were divided by the estimated duration of the pilot to get monthly variable costs and then extrapolated to get yearly costs. If one or more of these assumptions is incorrect, it would lead to over- or under estimation of costs.
- Estimated licensing costs of £333 per Trust per month were also included and based on technical costs from the PID. However actual licensing costs will vary as these are determined into the future.

Role of the CHA

Evaluation of delivering the programme as part of the CHA – quotes from qualitative feedback



“CHA was a very positive experience, lots of support and meetings had a spirit of mutual understanding”

“Useful to see how the hospitals have chosen to take on different types of implementation”

“Lots of secondary benefits - chats about other things lead to other areas of shared learning”

“brought us all closer together as organisations”

“Helpful monthly CHA meetings; enjoyed peer support and regular Trust spotlights”

“Once the whole process was working it is a really high quality, smooth and beneficial technical exchange between organisations”

Recommendations for implementation and next steps

Overall recommendation

- Trusts reported that it was easier to target interventions once they knew which patients were at risk; there was an overall drop of 52% in the WNB rate amongst the most underserved patients
- On the basis of the evidence we would recommend that Trusts move forward with using the AI tool to direct their WNB work, now the final product is available
- The programme identified some important points for implementation: see next slides



Tips for implementation: the AI tool



Developing the data agreement

- CHA Steering Group commitment to **developing single shared agreement across all Trusts** was essential: senior leadership and sponsorship
- **Leadership by Trust SIOs** on drafting the documents created ownership
- **Senior involvement** was necessary to overcome barriers

BI support

- **Data quality** was the greatest challenge faced by all Trusts, with some Trusts struggling to provide the data
- Dedicated **BI support of 0.2WTE** was required to clean and prepare data
- BI project leads in Trusts needed to be **senior enough** to take decisions
 - To be most efficient the tool needs to be **linked to the patient's EPR**
 - BI teams need to understand the **operational impact** of the tool

Implementation: the interventions to reduce WNB



The most effective intervention

- The pilots were relatively small scale so **we would not rule out any of the approaches** based on these results, with the exception of appointments in schools which were found to be effective but too work-intensive to be scalable
 - Trusts found that a single solution such as transport is less helpful than a flexible approach that can address the needs of the individual patient
 - Conversations with families were highly effective but most effective if led by admin with escalation to clinicians if necessary
 - Changes to the environment for ASD/ADHD patients have a less immediate impact but may be more sustainable

Dedicated resource to support the projects

- It is important that dedicated time and resources are made available. Developing staffing establishments like Alder Hey; Birmingham, Bristol, Leeds and Sheffield to continue delivering this work.

Next steps: AI Tool



BI support to be made BAU

- The CHA and AH Innovation have supported those Trusts who have struggled with capacity. This support with implementation is now coming to an end and Trusts will need to support the work internally as BAU

Funding the AI tool so that it can be made BAU

- 5 trusts have funded use of the tool internally, to make it BAU
- Some Trusts have paused use; 2 are currently drafting business cases for the necessary funding; 2 others intend to do so once new data systems are in place
- The CHA is meeting with the Charity CEOs to discuss whether funding can be made available to support Trusts in integrating the AI Tool with Power BI dashboard systems

Rolling out to additional CHA Trusts

- The CHA is working with the Charities to identify funding to bring Newcastle and Nottingham, as the two newest CHA members, into the project

Developing the commercial model

- Alder Hey Innovation is finalising the commercial model of the work on the AI tool:
 - Deployed the web portal version of the tool to five of the CHA, with the remaining trusts invited on June 23
 - WNB AI license agreement will end in December 2023, finalising the commercial model with a discounted rate for CHA members who wish to continue.



Next steps: interventions

Finding
funding to
continue
existing pilots

- The CHA has supported some Trusts to build the business cases to move their pilots to BAU

Reviewing
and agreeing
internal
needs

- The evaluation and individual case studies are available to support Trusts in deciding what interventions they might wish to take forward

Annex

Results of Trust interventions



Trust	Threshold of level of risk of WNB for inclusion in the pilot	Total no of patients included in the pilot	Intervention Outcomes:							
			Attended		Cancelled Prior		WNB'd		Unknown	
Birmingham Transport Call	80%>	4757	3405	71%	894	19%	323	7%	135	3%
Sheffield Transport Call	70%>	299	188	63%	0	0%	111	37%	0	0%
Sheffield Transport Additional Text	50-70%	1518	1015	67%	0	0%	501	33%	2	0%
Leeds Appointments in School	N/A	11	9	88%	0	0%	2	12%	0	0%
Bristol Patient Portal	80%>	236	103	44%	71	30%	30	13%	32	13%
GOSH Patient Portal	80%>	284	107	38%	109	38%	67	24%	1	0%
Oxford Admin Telephone Call	80%>	92	71	77%	0	0%	21	23%	0	0%
Southampton Admin Telephone Call	80%>	277	157	57%	69	25%	47	17%	4	1%
Evelina Admin Telephone Call & Clinician MDT	80%>	161	111	69%	32	20%	16	10%	2	1%
Alder Hey Clinician Call	80%>	272	128	47%	47	17%	96	36%	1	0%
Manchester Focused Support	N/A	35	16	46%	0	0%	17	49%	2	5%
Total		7942	5310	67%	1222	15%	1231	16%	179	2%

Using the AI Tool as BAU



BAU
embedded

Alder Hey, Bristol, Leeds & Sheffield have embedded the AI tool as BAU.
Birmingham has embedded the AI tool with funding due to end June 2023

BAU
business
case in
progress

Southampton has continued using the tool and is in the final stages of building a business case to identify resources to continue use of the AI tool as BAU.
Oxford has added the use of the AI tool into business plans for the new financial year and meeting with SAH Commercial leads in June 23.

BAU on
pause

GOSH has put the use of the AI tool on pause due to capacity and resources and the final evaluation results.

Evelina has put the use of the AI tool on pause in preparation for the deployment of a new EPR system, but has the infrastructure in place to restart it in 2024.
Manchester continues its bespoke approach rolling out the WNB focus across Greater Manchester Hospitals, but the CHA is scoping ways to support the implementation of the AI tool.