DrDoctor

AI DNA Prediction

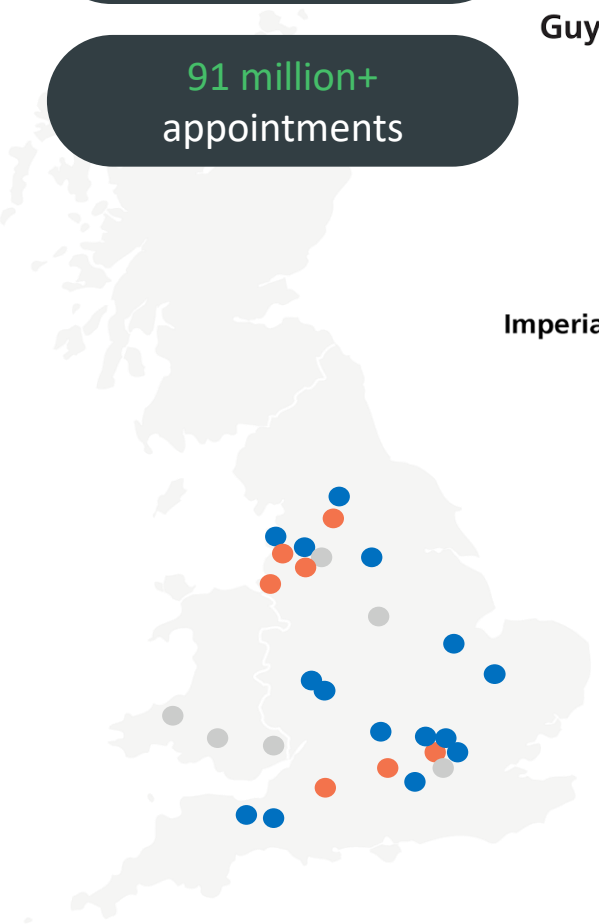
By Ross Farmer

Commercial Director

Who is DrDoctor:

19 million+ patients

91 million+ appointments

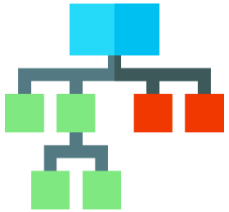


- Oxford University Hospitals NHS Foundation Trust
- Guy's and St Thomas' NHS Foundation Trust
- Airedale NHS Foundation Trust
- Imperial College Healthcare NHS Trust
- North Bristol NHS Trust
- The Princess Alexandra Hospital NHS Trust
- Royal Papworth Hospital NHS Foundation Trust
- The Royal Marsden NHS Foundation Trust
- Chelsea and Westminster Hospital NHS Foundation Trust
- Royal Berkshire NHS Foundation Trust
- Great Western Hospitals NHS Foundation Trust
- Nottingham University Hospitals NHS Trust
- Taunton and Somerset NHS Foundation Trust
- Aintree University Hospital NHS Foundation Trust
- Northern Care Alliance NHS Group
- The Royal Orthopaedic Hospital NHS Foundation Trust
- Imperial College Healthcare NHS Foundation Trust
- Central London Community Healthcare NHS Trust
- Birmingham Community Healthcare NHS Foundation Trust
- Northern Lincolnshire and Goole NHS Foundation Trust
- Great Ormond Street Hospital for Children NHS Foundation Trust
- Frimley Health NHS Foundation Trust
- Harrogate and District NHS Foundation Trust
- Doncaster and Bassetlaw Teaching Hospitals NHS Foundation Trust
- University Hospitals Birmingham NHS Foundation Trust
- Bradford Teaching Hospitals NHS Foundation Trust
- Manchester University NHS Foundation Trust
- GIG CYMRU NHS WALES – Bwrdd Iechyd Prifysgol Hywel Dda University Health Board
- GIG CYMRU NHS WALES – Bwrdd Iechyd Prifysgol Bae Abertawe Swansea Bay University Health Board
- GIG CYMRU NHS WALES – Bwrdd Iechyd Aneurin Bevan Health Board
- GIG CYMRU NHS WALES – Bwrdd Iechyd Prifysgol Cwm Taf University Health Board
- The AHSN Network NHS England – NHS Innovation Accelerator
- Southport and Ormskirk Hospital NHS Trust
- North West Anglia NHS Foundation Trust
- The Christie NHS Foundation Trust
- West Suffolk NHS Foundation Trust
- Wrightington, Wigan and Leigh NHS Foundation Trust
- Liverpool University Hospitals NHS Foundation Trust
- Moorfields Eye Hospital NHS Foundation Trust
- Digital Health. London ACCELERATOR

Our Projects

DNA Prediction

Identify patients who are going to DNA



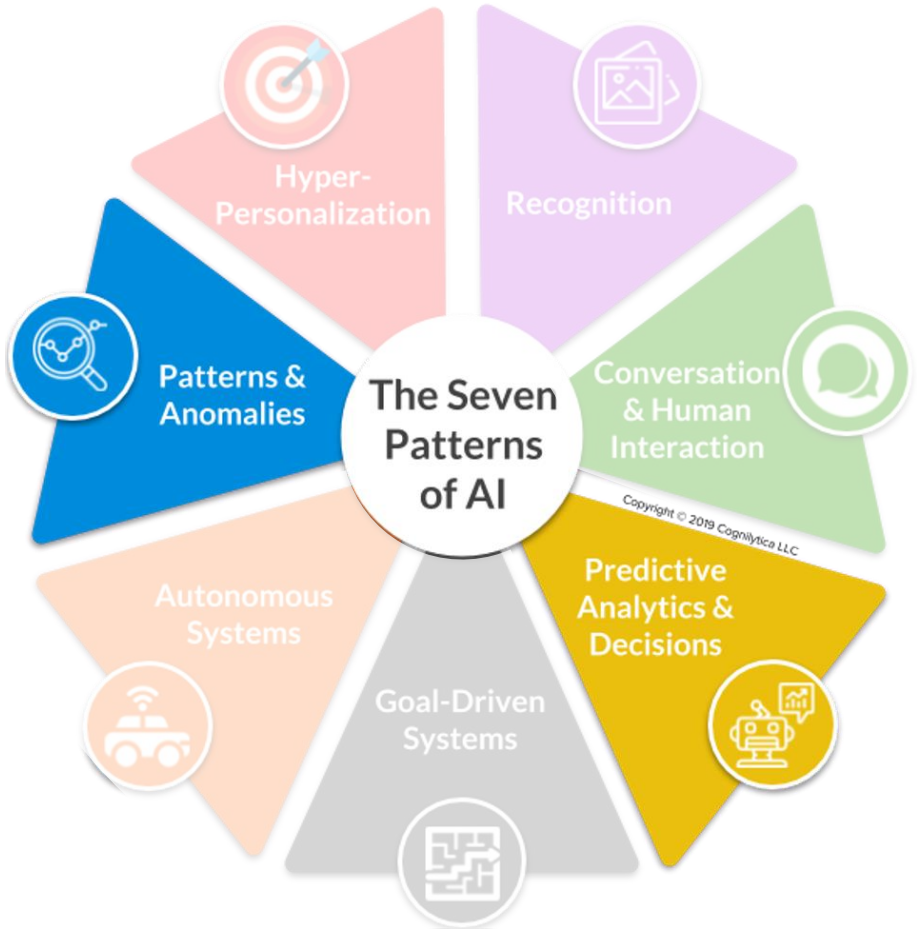
Linked Clinics

Group 'similar clinics' to enable better patient scheduling

Linked Appointments

Better pathway visualization and flag appointment dependencies

7 Patterns of AI



And established that the opportunities to apply to our field were within:

Pattern & Anomaly Detection

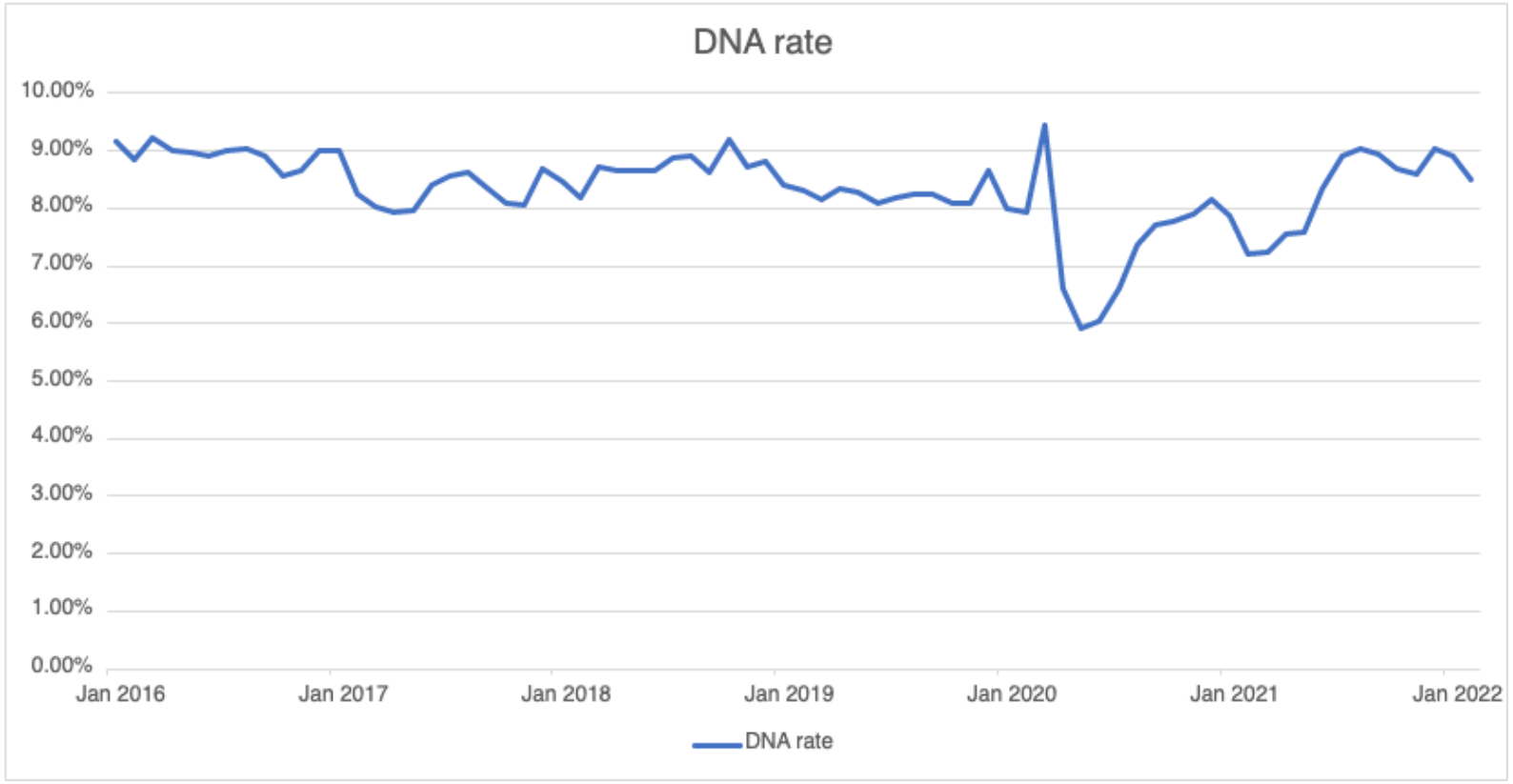
Predictive Analytics & Decision Support

The Business Problem

Missed appointments (DNA) are still a problem and are not going away.

Annually they cost the NHS £1 billion, so it is an important challenge for trusts to keep this rate as low as possible.

Best rate: 8% reported by the NHS 2018-19



Trend of DNA rate across all our trusts

Research: Why do patients DNA?

Existing Academic Research

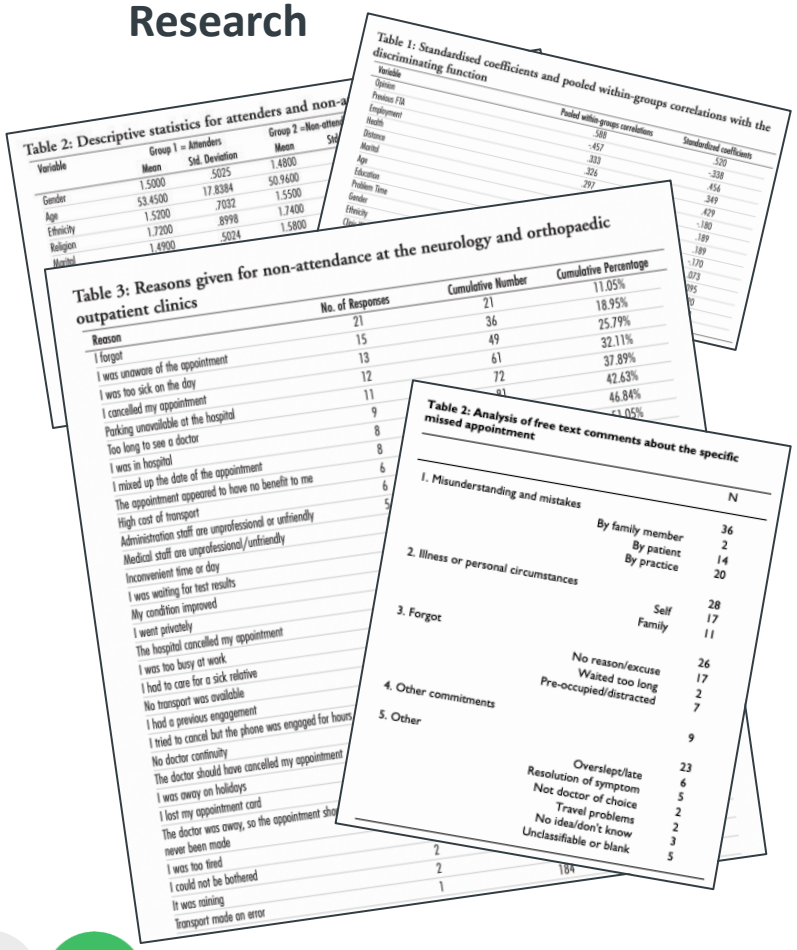


Table 2: Descriptive statistics for attenders and non-a

Variable	Group 1 = Attenders Mean	Std. Deviation	Group 2 =Non-attend Mean	Std.
Gender	1.5000	.5025	1.4800	
Age	53.4500	17.8384	50.9600	
Ethnicity	1.5200	.7032	1.5500	
Religion	1.7200	.8998	1.7400	
Marital	1.4900	.5024	1.5800	

Table 1: Standardised coefficients and pooled within-groups correlations with the discriminating function

Variable	Pooled within-groups correlations	Standardised coefficients
Opinion	.588	.520
Previous FTA	-.457	-.338
Employment	.333	.456
Health	.326	.349
Distance	.297	.429
Marital		-.180
Age		-.189
Education		.189
Problem Time		-.170
Gender		.073
Ethnicity		.095

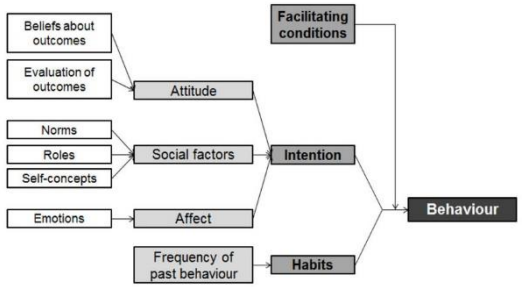
Table 3: Reasons given for non-attendance at the neurology and orthopaedic outpatient clinics

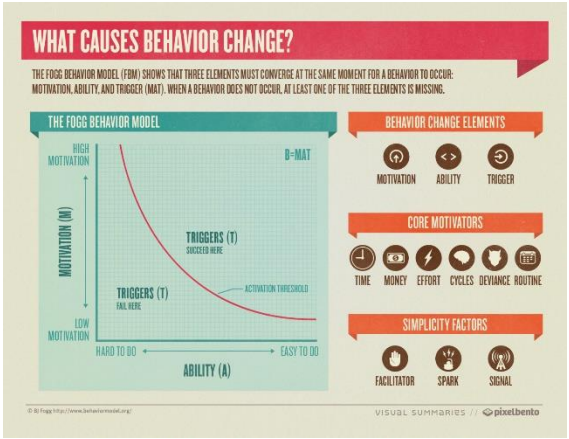
Reason	No. of Responses	Cumulative Number	Cumulative Percentage
I forgot	21	21	11.05%
I was unaware of the appointment	15	36	18.95%
I was too sick on the day	13	49	25.79%
I cancelled my appointment	12	61	32.11%
Parking unavailable at the hospital	11	72	37.89%
Too long to see a doctor	9		42.63%
I was in hospital	8		46.84%
I mixed up the date of the appointment	8		
The appointment appeared to have no benefit to me	6		
High cost of transport	6		
Administration staff are unprofessional or unfriendly	5		
Medical staff are unprofessional/unfriendly			
Inconvenient time or day			
I was waiting for test results			
My condition improved			
I went privately			
The hospital cancelled my appointment			
I was too busy at work			
I had to care for a sick relative			
No transport was available			
I had a previous engagement			
I tried to cancel but the phone was engaged for hours			
No doctor continuity			
The doctor should have cancelled my appointment			
I was away on holidays			
I lost my appointment card			
The doctor was away, so the appointment sho			
never been made			
I was too tired	2		
I could not be bothered	2	184	
It was raining	1		
Transport made an error			

Table 2: Analysis of free text comments about the specific missed appointment

		N
1. Misunderstanding and mistakes	By family member	36
	By patient	2
	By practice	14
2. Illness or personal circumstances		20
3. Forgot	Self	28
	Family	17
		11
4. Other commitments	No reason/excuse	26
	Waited too long	17
	Pre-occupied/distracted	2
		7
5. Other		9
	Overslept/late	23
	Resolution of symptom	6
	Not doctor of choice	5
	Travel problems	2
	No idea/don't know	2
	Unclassifiable or blank	3
		5

Behavioural Science Frameworks & Theories





Operational Practice / Direct Feedback

NHS
Nottingham University Hospitals
NHS Trust

- Patient Interviews
- Staff Interviews
- Workshops
- Data Analysis

Common DNA themes?

Combining the research and frameworks, we can summarise 4 key reasons:

	Context	*Example*
Intention	The patient has made a decision not to attend based on perceived outcomes/consequences from the appt, social pressure/factors or emotions	*"I work a zero hours contract, if I miss work to get my leg checked out, I can't pay rent this month to support my family. It doesn't feel too bad so I'll just power through"*
Facilitating Conditions	Environmental factors that physically or mentally prevent the patient attending	*Physical: "There's no public transport at that time of day."* *Mental: "I wasn't even aware of the appointment!"*
Habit	A patient has a history of missing appointments	***The NHS is free, so I don't feel the need to let them know when I'm not coming.*** *Wrong contact details for patient so they miss all appointments*
Trigger	A patient doesn't get 'nudged' and forgets to reschedule or attend	*I knew I have a virtual video appointment in 20 minutes but got distracted watching TV and forgot to join*

What are we doing about it?

How does the model work?

The model is made up of 42 features

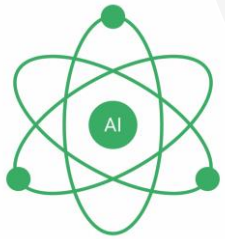
Example Features

- Days since last booked
- Specialty
- Day of the week

- Reminders enabled
- Contact details up to date

- # of previous appts
- # of previous DNAs
- # of previous cancellations

- Reminders enabled
- Appt format (eg. Video, phone, etc)



The prediction is run against the **patient** within their booked **appointment**

Our Solution

We have a model that can effectively identify appointments that are likely to DNA.

This model powers 2 interventions…

Intervention 1: Manual Calls

- A page powered by the DNA model with the portal that is used to prioritise calls for Booking Teams
- Trusts can set a threshold of patients that they want to contact (eg. patients who are 60% likely to not attend their appointment)
- Calls are made manually as normal, and the Booking Team updates the contact status within the portal to log whether the patient has advised they will attend, has cancelled their appointment or has amended their appointment.

Intervention 2: Smart SMS Reminders

- A 'filter' that sits on top of existing 'extra' reminders.
- The DNA model highlights patients that are most likely to not attend their appointment. The Trust selects the threshold as in Intervention 1, and an automated SMS is sent out to high likelihood patients.

This intervention is best either for Trusts who do not currently have both reminders switched on, have neither reminders switched on or who are looking to bring down what they are spending on reminders without increasing their rates of DNA dramatically.

Results so far...

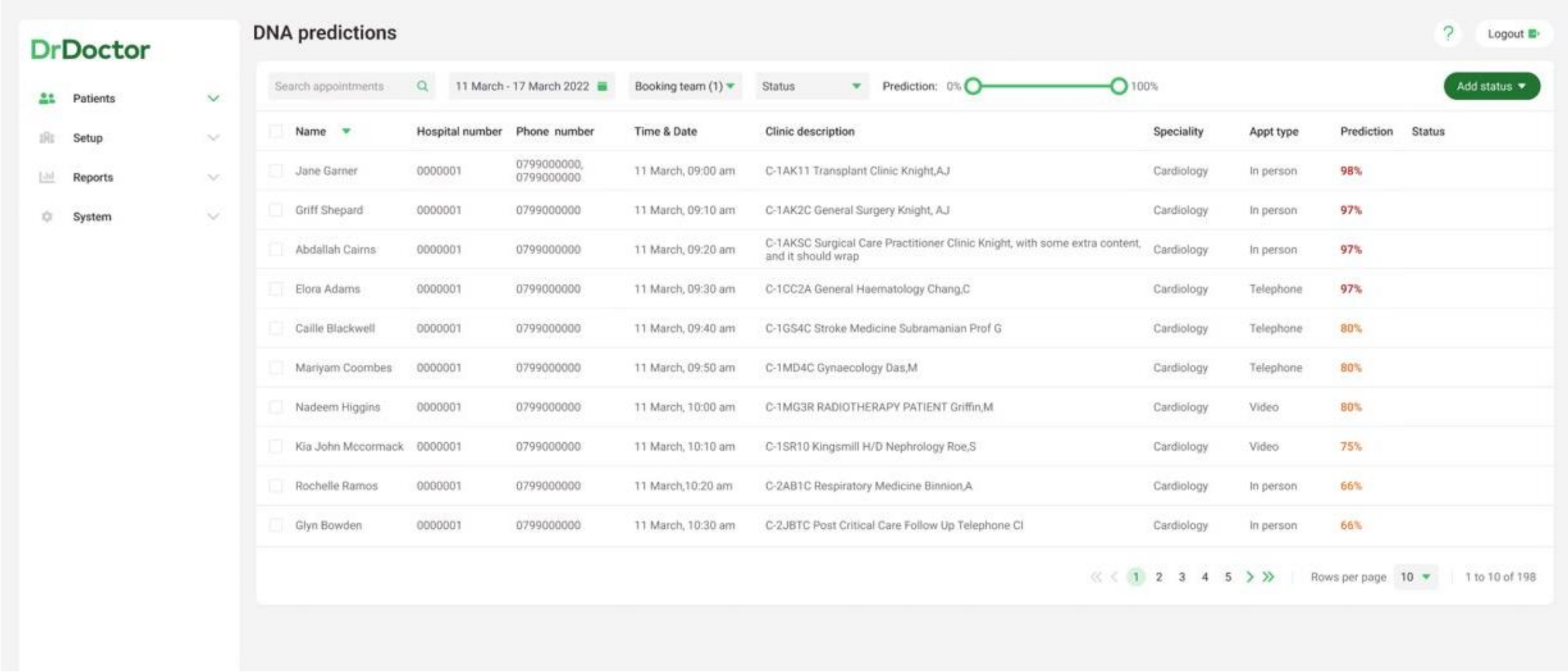
The NUH pilot so far…

Since the beginning of the pilot, we have generated DNA predictions for over 400,000 appointments

In NUH we have made 1500 phone calls, informed by the patient's likelihood to DNA

We have sent 2350 smart reminders and skipped sending 3800 reminders to those below the threshold

DNA Predictions Page



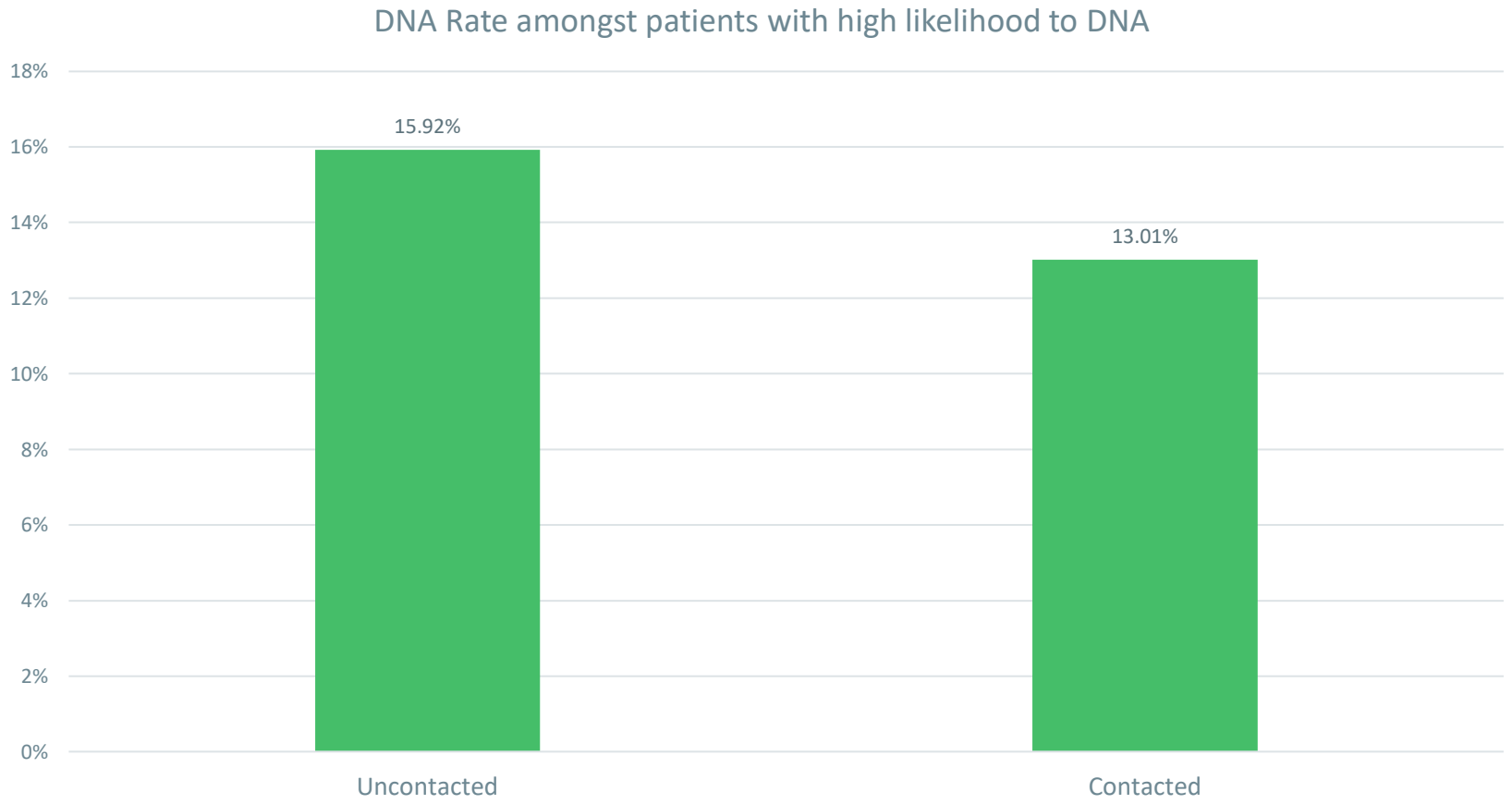
Key learnings

DNA rate varies each week, so it is very hard to tell whether any variations are caused by the interventions, or natural seasonality.

However, we have been able to pick out some key learnings from the pilot:

- Among those with the highest likelihood to DNA, phone calls reduced their DNA rate by 2.9 pp
- The DNA Prediction informed method of contacting patients is more effective than the previous method
- Smart Reminders are working well amongst most patients and are an ideal product to try if secondary SMS aren't already in place

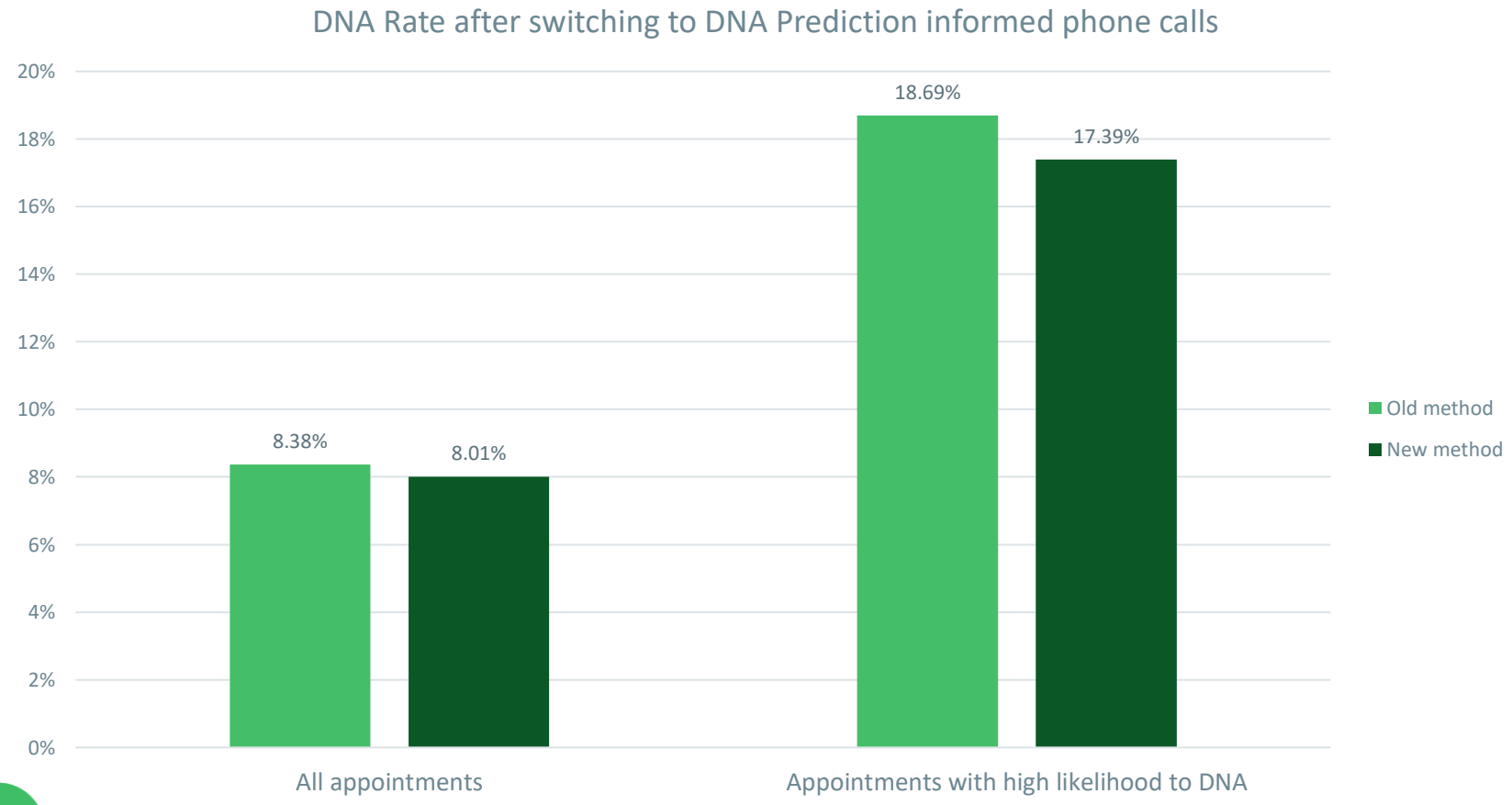
Among those with the highest likelihood to DNA, phone calls reduced their DNA rate by 2.9 pp, or 18.28%



When we look at the patients in the highest 30% of DNA predictions, those that we contact via phone calls have a lower DNA Rate

Phone calls are working as an effective way to reduce DNA

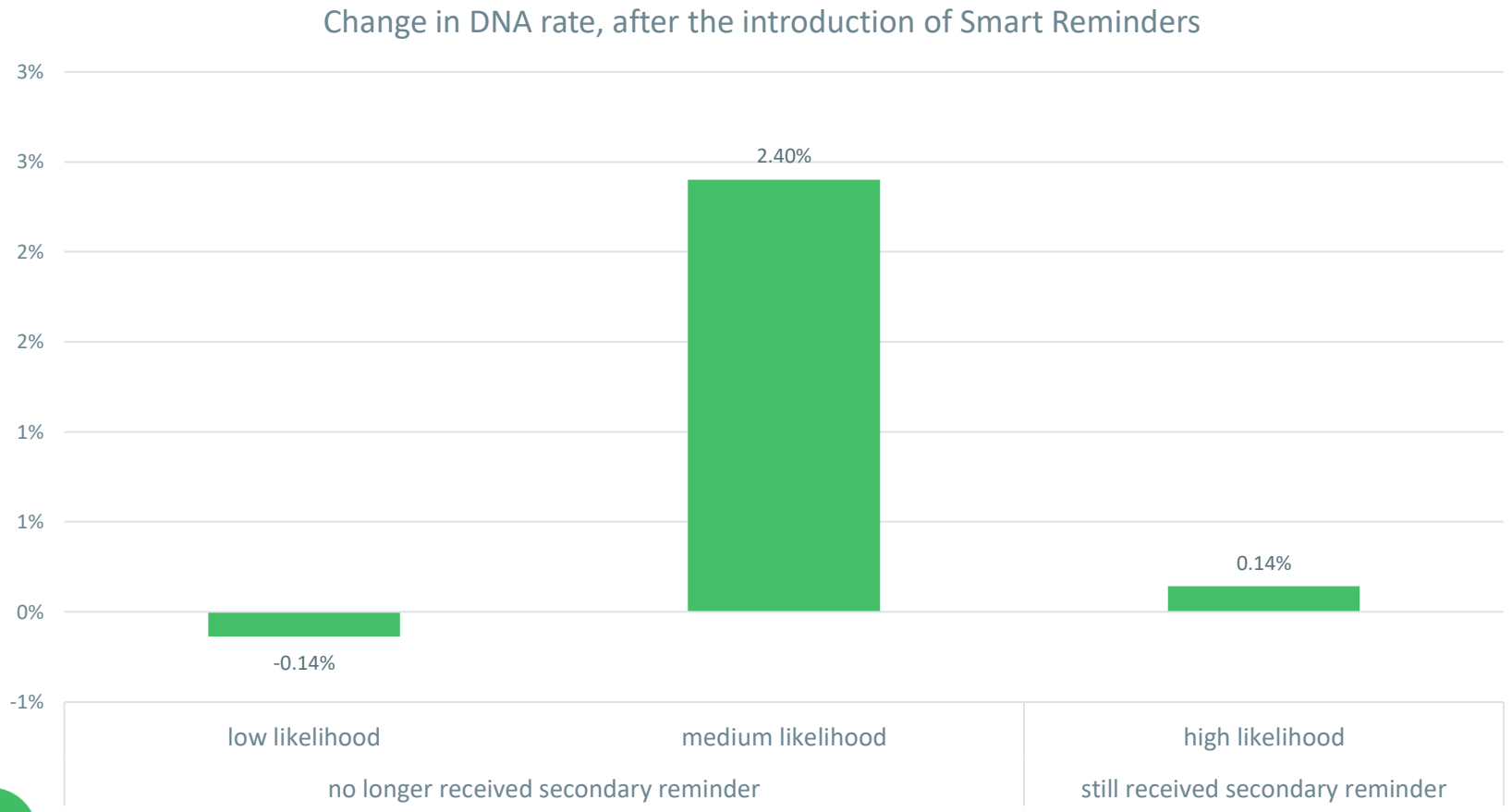
The DNA Prediction informed method of contacting patients is more effective than the previous method



DNA rate has reduced within the Gateways piloting the DNA Prediction informed phone calls. This is especially true when we look at the patients in the highest 30% of DNA predictions, their DNA rate has reduced by 1.3pp

We are better using the phone call resource to target customers that wouldn't have attended their appointment

Smart Reminders are working well amongst most patients, but we should lower the threshold



The DNA rate amongst those above the threshold for receiving a smart reminder have seen consistent DNA rates

Those with low likelihood to DNA have also seen very little change, suggesting these patients will attend regardless of receiving a reminder

However, the patients with medium likelihood to DNA had a significant increase in their DNA rate. Suggesting that the reminder was key here and we should lower the threshold from 0.7 to 0.5

From good...

To GREAT!

Benefit to Effort Curve Explained

This approach is a lot more effective than selecting appointments at random

Effort	Benefit
10%	40%
20%	60%
30%	73%
50%	88%
100%	100%

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