C2-Ai

Addressing the elective recovery/waiting well and fuel poverty challenges for vulnerable groups

YHAHSN – Population Health Management roundtable

Copeland Clinical Ai (C2-AI) Patient Tracking List System

Copeland Clinical Ai (C2-AI) principles:

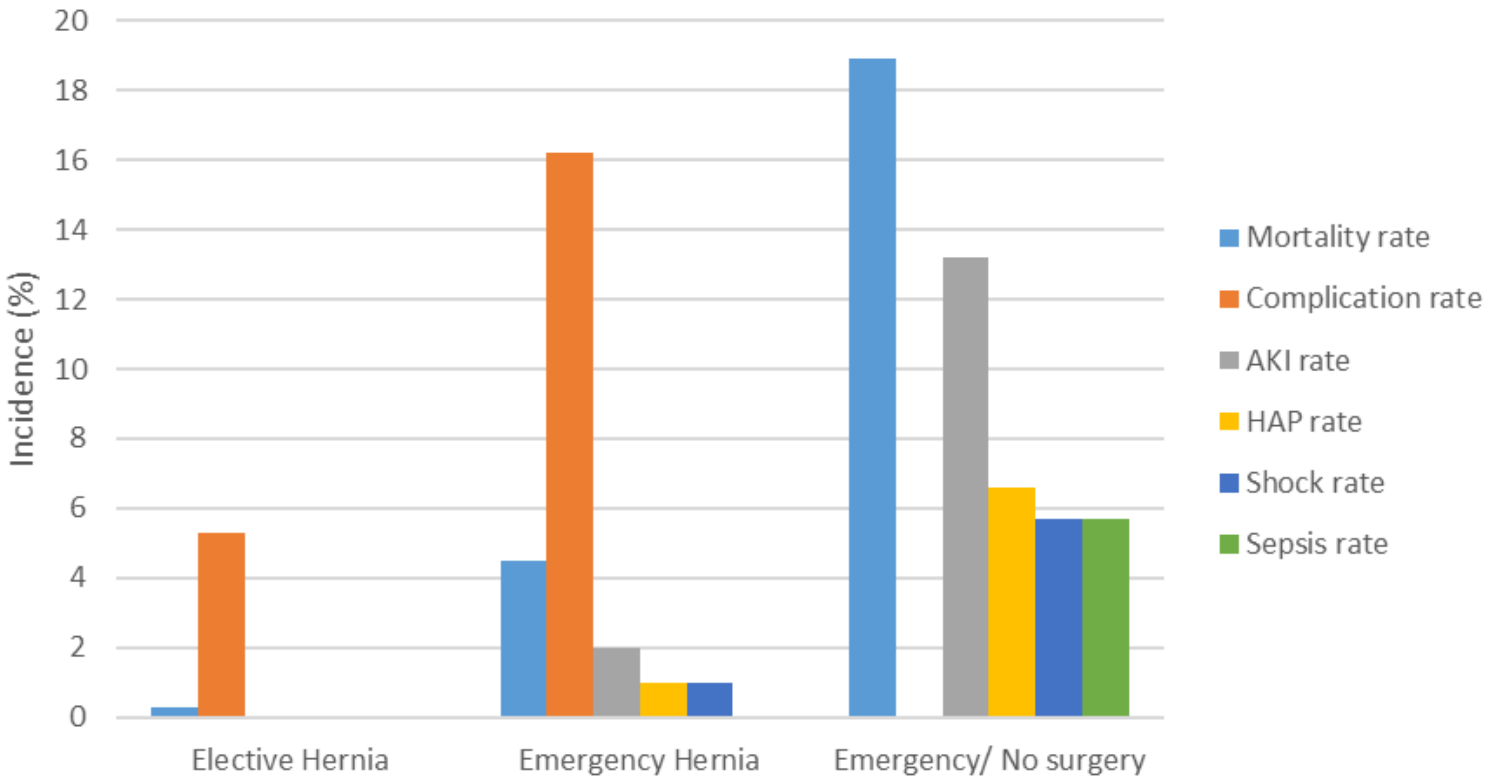
- Primary objective to reduce avoidable harm & variation and improve outcomes for patients
- Identify best practice, problem areas, root cause and above all, propose actionable solutions
- Deliver quality-based savings
- Made by clinicians for clinicians: not a policing system, guarantees clinical engagement in improvement efforts

This presentation is based on pilot trials and deployments now ongoing across multiple trusts and regions.

Figures are internal NHS findings except C2-Ai company information or as indicated.

AMBITION – Reduce patient deterioration awaiting surgery

Patients waiting longer are more frail, have worsening comorbidities and pathophysiology (example - observed differences for hernia repair)



Example – Here is one group of patients you could treat electively if you triage effectively. If you don't do this, 16% will remain in hospital with complications, blocking beds, increasing mortality and delaying clearing the backlog.

Data requirements from the Trust and system outputs

Patient co-morbidity/diagnosis data

- Some trusts collate co-morbidity data routinely based on previous admission coding
- In the absence of this, the co-morbidity data for waiting list patients can be extracted from a minimum of one year download of all coded data (HES data)
- If a patient has no preceding admission, an assumption will be made that there are no significant co-morbidities

Procedure data

- All patients are given an intended procedure code
- This can usually be completed by the coding department within 8 hours usually the closest likely codes

C2-Ai

Precision Healthcare - AI-driven | Saving Lives - Reducing Harm

System outputs

- Patient identifier (hospital number)
- Patient identifier (NHS number)
- Date of birth
- Date first listed
- Current length of time on the waiting list
- Intended procedure
- Intended procedure code
- Surgeon supplied priority
- Procedure specific priority “P” code
- Overall risk of death
- Overall risk of complication
- List of specific complications with a risk over 2.5% highlighted
- Change in mortality risk if surgery delayed (magnitude of change)
- Change in overall complication risk if surgery delayed (magnitude of change)
- Change in complication profile if surgery delayed (magnitude of change)

Automated risk-based prioritisation with zero integration

HOW IT WORKS – Precision insights via smart algorithms

Largest patient dataset – +300M from 46 countries

Military grade encryption and information governance within HSCN network
NHSx DTAC & DCB0129 compliant

Hospital coded data

- No integration
- 1 day IT time
- Flat CSV file template

Ai Engine

+25 years research
+300 publications - optimising POSSUM-based risk adjustment algorithms

PTL risk based prioritisation and scheduling

Analytics database

Previously unattainable insights on risk of deterioration and opportunities for prehabilition

SDoH - Prospective analytics of equality of care and clinical outcomes

OBSERVATORY - System wide horizon scanning to identify and eliminate patterns & trends in avoidable harm and variation

BENCHMARKING - Hospital level performance analytics

The weighted scoring system combines information to calculate a matrix priority score for each patient

Built in pivot table functionality and CSV download of full Patient Tracking List (example below)

Trust Inputs

Subset viewed within pivot table

Priority Points Score (0-100)

Patient	Gender	DoB	Procedure		List Date	Wait (weeks)	Priority	Code 1/2	Mortal Risk Change (%)	Complication Risk Change (%)	Speciality	Points
1000002	M	1939-05-27	M093	Laser Lithotripsy	2020-10-21	20	P3	2 / 3	0.9	7.1	101	56
1000003	F	1945-10-18	C794	Intravitreal Injection La	2021-02-05	4	P2	3 / 4	0.0	0.0	130	37
1000005	F	1953-02-16	J183	Laparoscopic Cholecystectomy	2020-10-26	19	P3	3 / 4	2.8	15.7	106	50
1000006	F	1943-02-01	W373	Hip-Arthroplasty,Revision,Total,Cemented	2020-07-21	33	P2	3 / N	0.0	0.0	110	56
1000008	F	1941-06-24	T209	Inguinal Hernia Repair	2020-02-20	54	P4	4 / N	0.7	5.3	100	38
1000009	F	1960-07-19	W379	Hip replacement	2021-02-15	3	P2	3 / N	0.0	0.0	110	42
1000010	F	1938-09-02	W371	Hip - Arthroplasty, Primary,Cemented	2020-12-14	12	P4	4 / N	0.0	0.0	110	8
1000011	F	1957-12-02	T744	Finger Injection	2021-02-15	3	P4	4 / N	0.0	0.0	110	4
1000012	M	1949-01-31	M434	Botox Injection Into The Bladder	2020-10-12	21	P2	2 / 3	0.0	0.0	101	56
1000014	M	1959-11-05	W401	Knee - Nexgen Total Knee Replacement	2020-02-25	54	P4	4 / N	0.0	0.0	110	23
1000015	M	1939-05-14	W401	Knee - Nexgen Total Knee Replacement	2020-07-15	34	P3	4 / N	0.0	0.0	110	32
1000016	F	1943-09-29	E148	Functional Endoscopic Sinus Surgery	2020-10-27	19	P4	4 / N	0.0	0.0	120	13
1000017	F	1959-01-20	F443	Parotidectomy	2020-06-17	38	P2	3 / N	0.0	0.0	120	56
1000018	F	1940-01-30	T872	Excision Neck Node	2021-02-06	4	P2	2 / 3	0.0	0.0	120	47
1000019	M	1949-10-26	C751	Cataract Extraction - Right	2020-12-10	12	P3	3 / 4	0.0	0.0	130	26
1000020	F	1947-07-08	C751	Cataract Extraction - Right	2020-03-20	50	P4	3 / 4	0.0	0.0	130	22
1000024	M	1972-08-29	T723	Hand - Finger Trigger, Release	2020-09-09	26	P3	4 / N	0.0	0.0	110	27
1000025	F	1944-12-16	C751	Cataract Extraction - Right	2020-02-11	56	P4	3 / 4	0.0	0.0	130	27
1000026	M	1938-09-28	W371	Hip - Arthroplasty, Primary,Cemented	2019-10-29	71	P3	4 / N	0.0	0.0	110	37

C2-Ai OUTPUTS

FULL OUTPUT LIST

- **Priority score from the weighted matrix**
- RCS procedure priority (code 1/2)
- Overall risk of death
- Overall risk of complication
- List of complications with a risk over X%
- Incremental change in mortality risk if surgery delayed
- Incremental change in overall complication risk if surgery delayed
- Change in complication profile if surgery delayed
- Complete PTL (as CSV file)

SOLUTION – Risk-adjusted prioritization of patient treatment list

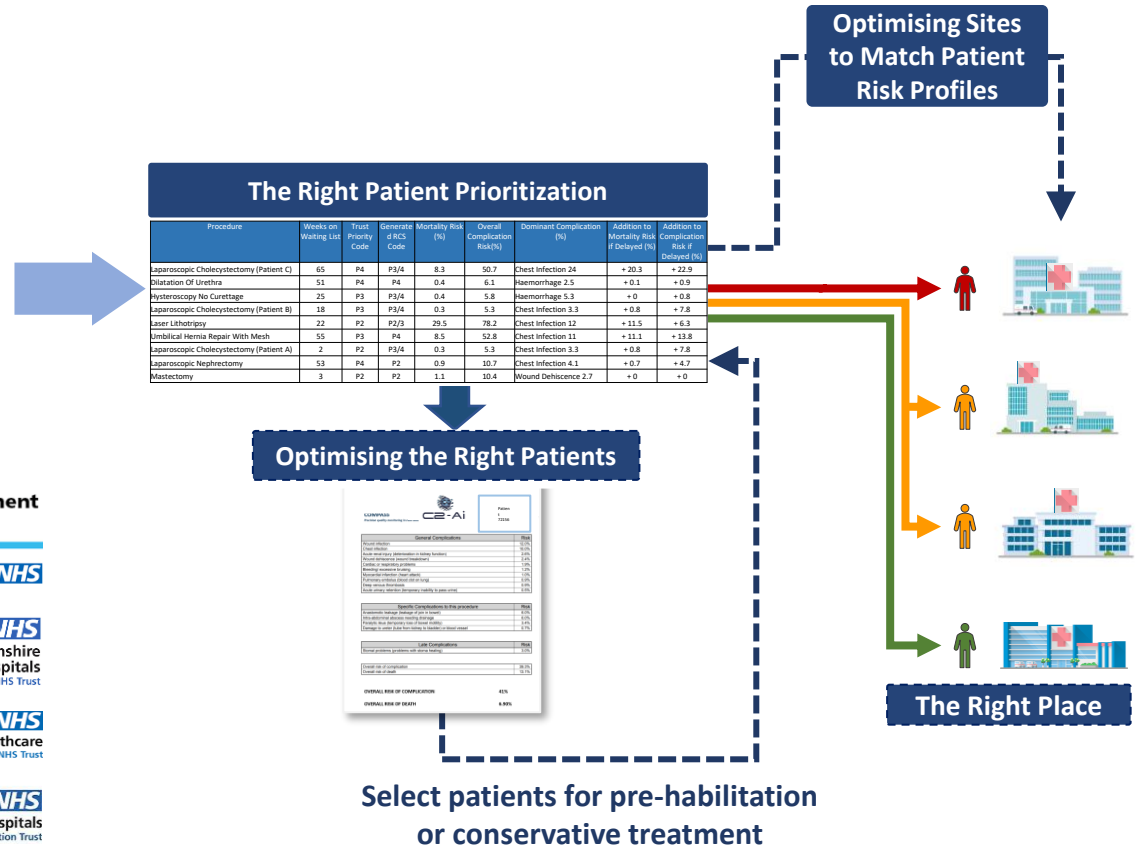
Risk-assessment and prioritization of the missed case list for elective procedures

"The right patient in the right place at the right time"

Risk-adjustment for mortality, complications, deterioration at patient level

PTL
PRIORITIZATION SYSTEM
commissioned by
NHS England and NHS Improvement

St Helens and knowsley Teaching Hospitals NHS Trust
United Lincolnshire Hospitals NHS Trust
Imperial College Healthcare NHS Trust
Liverpool University Hospitals NHS Foundation Trust
Warrington and Halton Teaching Hospitals NHS Foundation Trust



IMPROVEMENT SAVINGS

+5 mins saved of clinician time per patient per prioritization

8% reduction in A&E admissions

125 bed-days saved per 1000 patients on PTL

SYSTEM IS TRUSTED

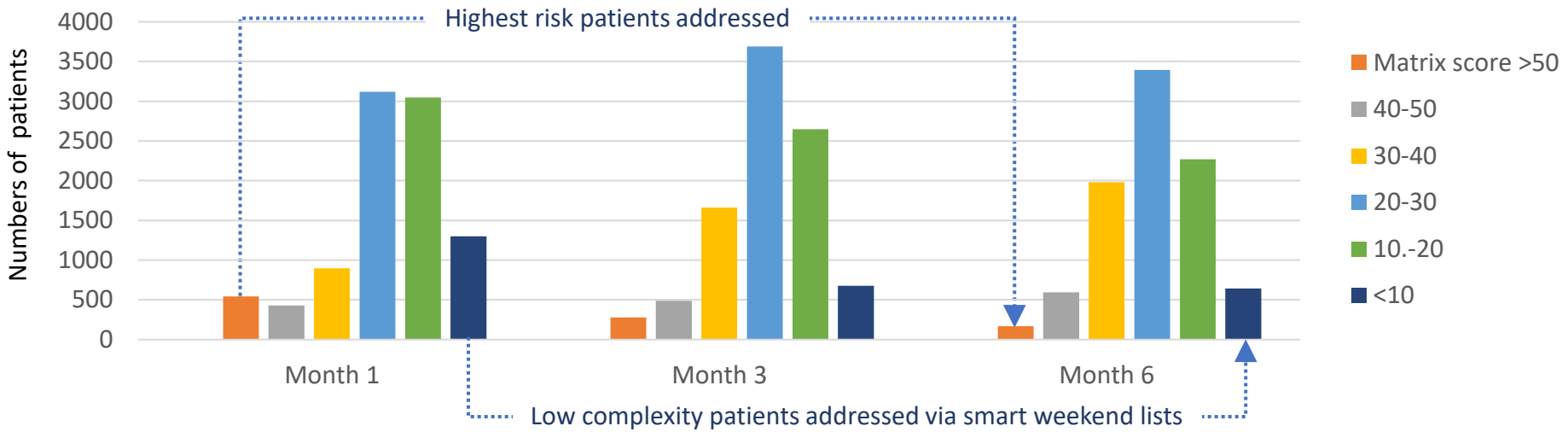
15% of cases have a priority mismatch (system priority vs C2-Ai system)

- **95%** Clinician concurred with C2-Ai reprioritisation
- **5%** unchanged due to qualitative factors captured in score matrix

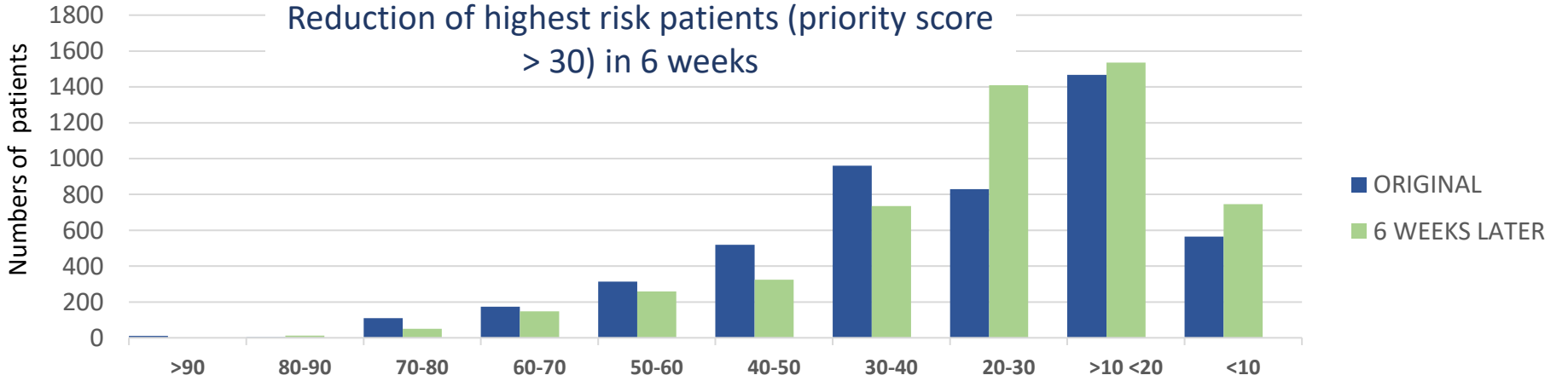
27% reduction in >52 weeks waits and highest priority scoring patients

The prioritisation approach using the C2-Ai matrix priority score is trusted and having an impact in multiple hospitals

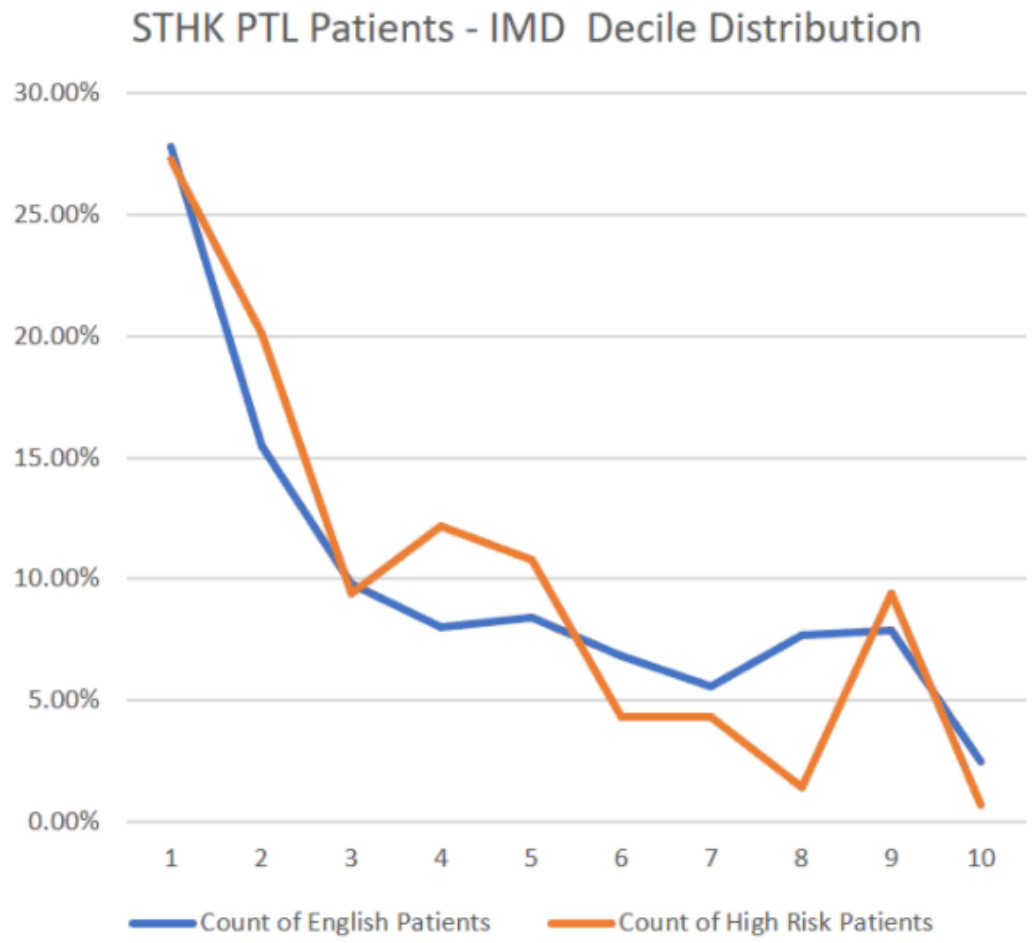
IMPACT A



IMPACT B

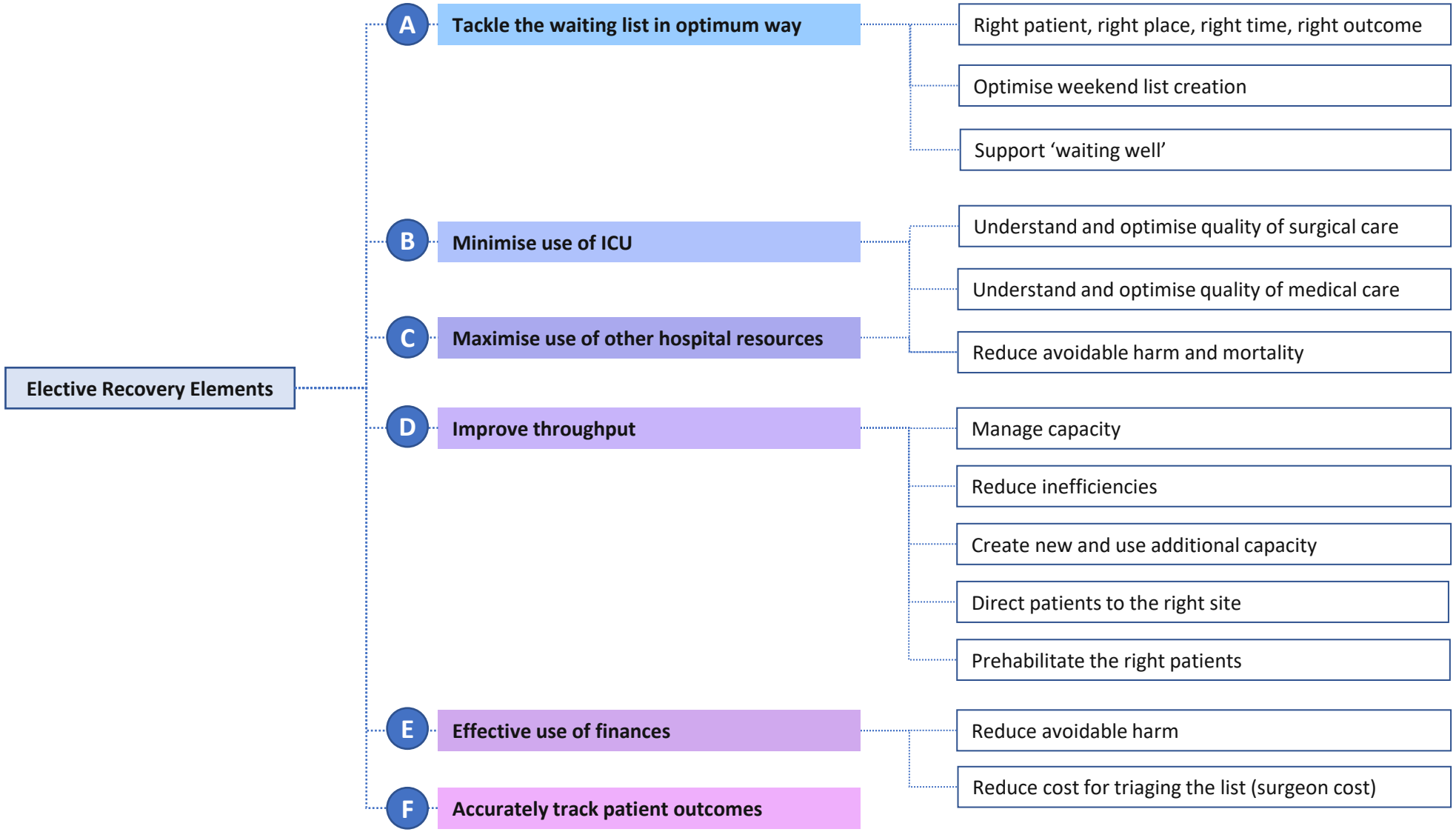


SDoH elements are included in the risk stratification based on clinical need

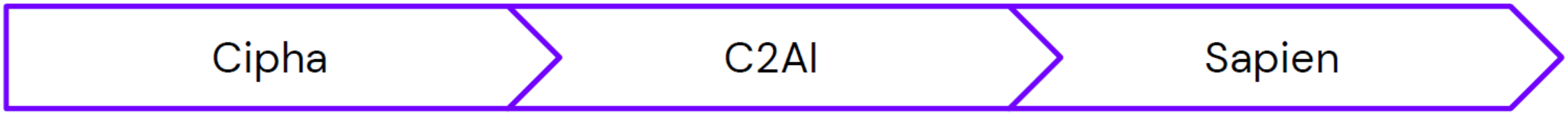


1.Comparison of co-morbidity coding between different areas

Providing improvements and insights to drive elective recovery



PHASE 1: Simplified pathway to accelerate roll-out



Comprehensive primary and secondary care datasets

Identify patients at high risk of chest infection

Periop health coaching programme incl. chest infection interventions

C2-Ai uses smart triage to identify at risk patients

- Initial focus on post operative chest infection risk >10%

	Total Compass Patients	Total patients any specific risk >10%	Chest infection	Wound infection	Wound dehiscence	Hemorrhage
St Helens	5225	142	138	3	3	1
Royal Liverpool	10,529	399	370	33	3	-
Warrington	416	48	41	7	-	-
Total	16,170	589	549	43	6	1

Having identified the higher risk chest infection patients we propose the following additional features

Incentive spirometer, video lessons on use & breathing exercise plan

THE CURE PROJECT
CURING TOBACCO ADDICTION IN CHESHIRE AND MERSEYSIDE

Links to local services eg. The Cure Project for smoking cessation

Emphasis on physical activity, pain management, hydration and oral hygiene

Empowering patients to identify early signs of infection and signpost appropriately

Outcomes

How do we measure success of this project...

Primary Outcome Metric

Postoperative Pulmonary Complications (PPC)

Secondary Outcome Metrics

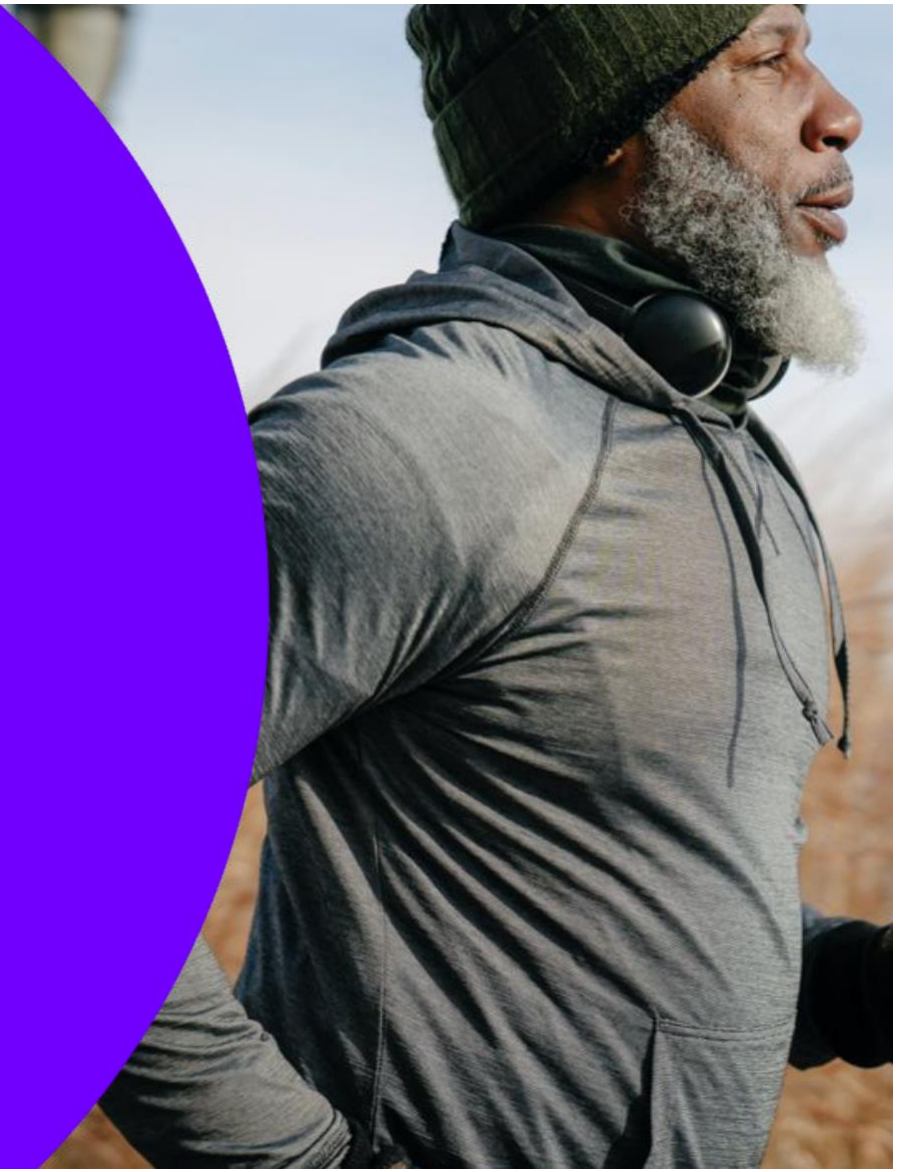
Patient Activation Measure (baseline & post program)

Cancellations

30-day Readmissions Rates

Average Length of Stay

Self-rated behaviours (baseline & post program)



SOLUTION – Risk-adjusted tracking of patient outcomes

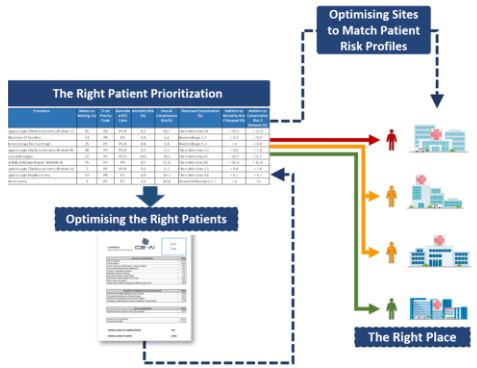
Ensuring patient outcomes during elective recovery and inform transformation

ELECTIVE RECOVERY INITIATIVES

Freeing up surgeon time

Increasing capacity

Private sector capacity



Theatre light settings

Increasing utilisation

C2-Ai PTL Prioritisation System

Effective prehabilitation

PTL Outputs Informing Initiatives

Reducing inefficiencies

C2-Ai OBSERVATORY

9x more visibility and resolution of issues

Detailed, evidence based analytics on all acute patient outcomes

Tracking and improvement of outcomes across acute care – e.g. for SDoH

Monitor patient impact of initiatitives

Identify bottlenecks/inefficiencies across acute care

Demonstrable, evidence-based insights:

- Supporting fast and effective improvement initiatives
- Maintaining/improving quality and patient safety

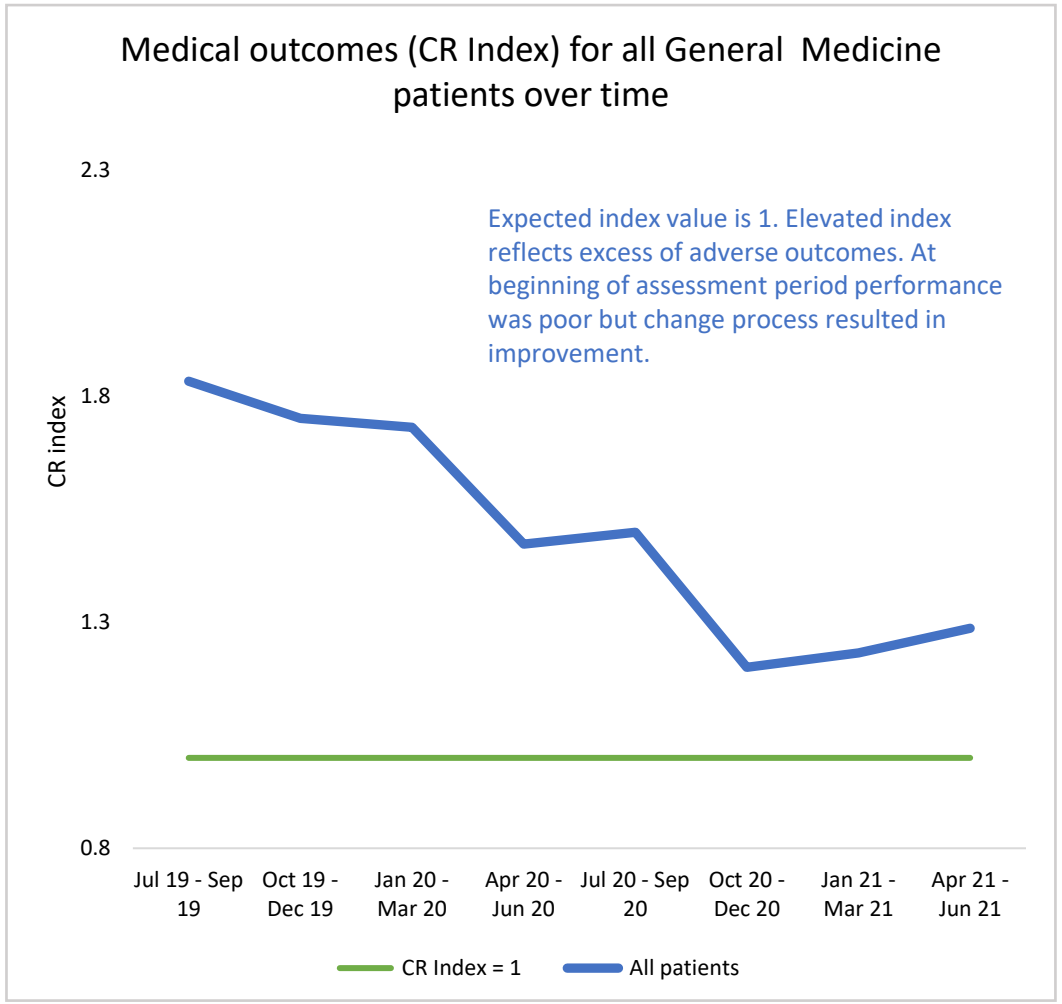
STRATEGIC AND QUALITY TRANSFORMATION

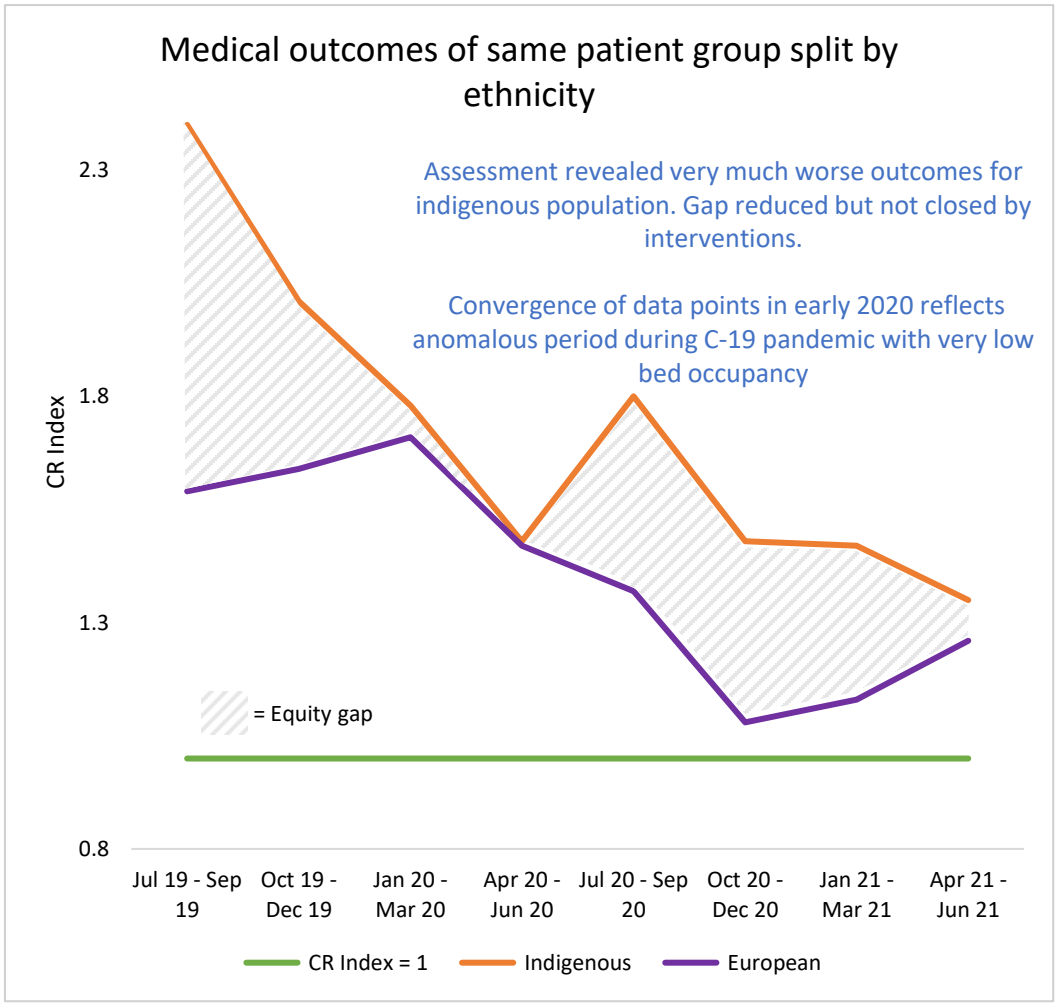
C2-Ai Observatory:

- Right patient in the right place at the right time
- Supports keeping patients out of hospital and management in the community
- Informs intelligent choices for service configuration, particulary for specialist services – what can be centralised, what is in a hub, critical care provision etc.
- Avoids hospitals running out of control – e.g. maternity scandals being managed

C2-Ai in action – 'Real World' examples

Identifying poor outcomes and quantifying the equity gap in a hospital's general medicine service





C2-Ai in action – 'Real World' examples

Service wide assessment revealed significant gaps in equity of outcomes in some areas but not all
Priorities for attention easily identified

Diagnosis group	Indigenous population (Observed/expected adverse events)	Others (Observed/expected adverse events)	Equity Gap % greater adverse outcomes for indigenous population
General Medicine - Overall	1.48	1.26	17%
Diabetes	1.17	1.13	4%
COPD	1.32	1.16	14%
Myocardial Infarction	1.08	0.71	52%
Stroke	1.0	0.95	5%
Dialysis	1.03	0.97	6%

In the same hospital case mix adjusted outcomes in General Surgery were equitable but analysis showed Indigenous patients

- Were presenting later in their disease course reflecting poor access to hospital services
- Were suffering from a different mix of conditions, reflecting poor general health with more comorbidities

Detailed analysis leads to valuable insights for healthcare providers in the Community

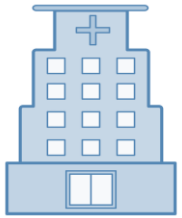
Problem Statement

Millions of UK households live in colder homes due to high inflation last 30 years

Fuel Poverty **Tripled** in a year

Not being able to warm their homes can exacerbate **Circulatory** and **Respiratory** systems

Anxiety and depression are **more prevalent in cold homes**



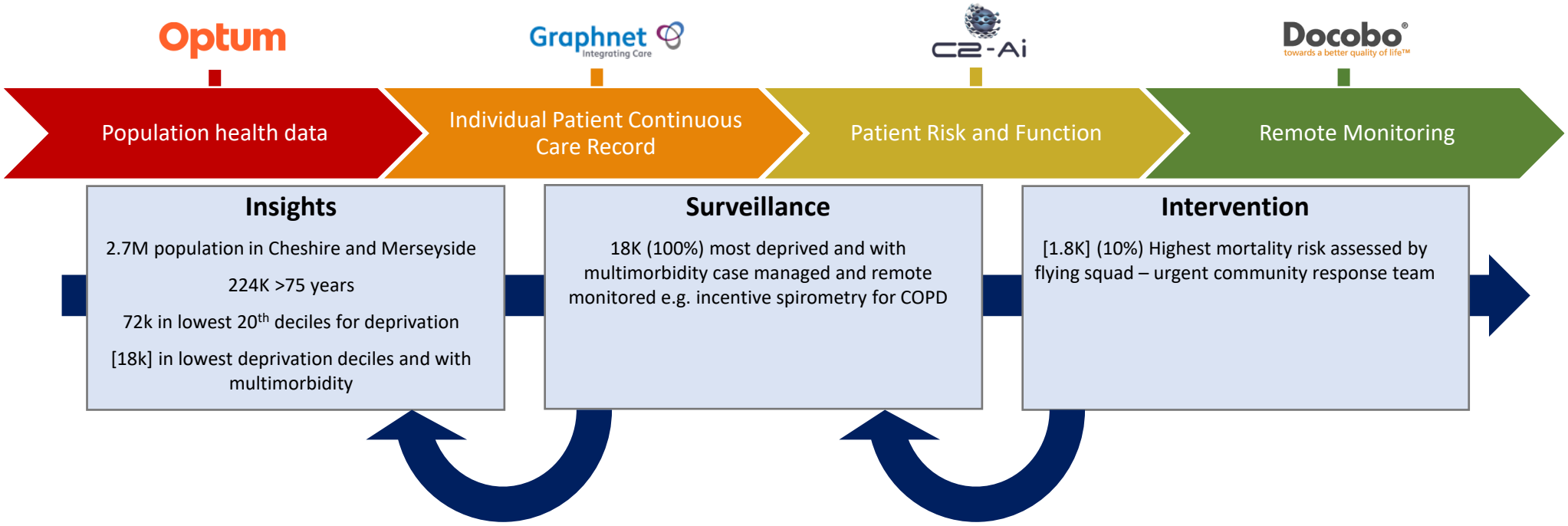
People living in fuel deprived areas are at **greater risk of admission to hospital**

Fuel poverty is defined as “the problem of someone on a “lower income [living] in a home which cannot be kept warm at reasonable cost” (Kwarteng, 2021)

Anticipatory Action Plan for Vulnerable People living with Chronic Conditions To Address Impacts of Fuel Poverty and Winter Pressures

Insights from existing datasets to anticipate changing demand and prevention of hospital admissions:

- Inability to improve mortality rates and reduce demand on NHS from unplanned A&E attendances/ admissions as there is an inability to capture dynamic patient risk and root cause analysis
- Fuel poverty increase will most likely lead to increased demand and higher deaths this winter
- Utilise smart triage to **expand access and expedite NICE approved approaches** to 5 clinical areas of need starting with respiratory and cardiovascular



PROSPECTIVE RISK ASSESSMENT AND PREVENTION

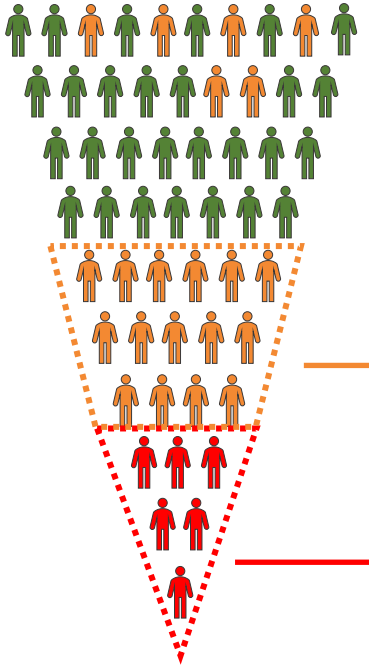
PROBLEM – Acute Trusts are at breaking point trying to manage TODAY's workload

Increasing numbers of patients living with chronic illness are likely to decompensate at home due to **winter illness** and impacts of **fuel poverty**

Delays in outpatient appointments and lack of acute/ ICU beds due to winter pressures and staffing issues are exacerbating the situation

Increased numbers of preventable deaths and bed blockages due to uncontrolled acute bed and ICU admissions along with delays in discharges home are likely to more than treble this winter

SOLUTION – Anticipation of TOMORROW's demand in order to proactively prevent and minimise burden on NHS



Graphnet Integrating Care → C2-Ai → Optum → Doc Abode

Docobo towards a better quality of life™

CONTINUOUS CARE RECORD/ REMOTE PATIENT MONITORING
Regional data hub for social, primary, secondary and mental health records and remote patient monitoring

MORTALITY RISK TRIAGE
Automated, real-time smart triage of continuous healthcare record and direct patient quality of life data to identify those at highest risk

DEPRIVATION/ FUEL POVERTY MAPPING
Identification of high risk economic groups based on population health data and management design/ coordination with social, housing and community pharmacy

FLEXIBLE CLINICAL WORKFORCE MANAGEMENT
Case management resource and urgent community response coordination based on availability, proximity and expertise

AT RISK OF DETERIORATING INDIVIDUALS

- **Increasing mortality risk trend identified**
- **Remote case management** coordinated by regional hub
- **Urgent community response Team** as required (incl. community pharmacy, social and housing agencies)
- **Medications review** and optimisation plan
- **Remote patient monitoring/ surveillance within acceptable threshold**

HIGH MORTALITY RISK INDIVIDUALS

- **Highest mortality risk individuals identified with lung and cardiovascular disease**
- **Score Matrix trigger/** red flag thresholds breeched
- **Urgent Community Response Team/ 'Flying Squad'** deployed (incl. community pharmacy, social and housing agencies)
- **Rescue medications review**
- **Remote patient monitoring/** surveillance beyond acceptable thresholds
- **Planned ward attendance/ Virtual Wards** - if continued decompensation/ thresholds breeched

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