HEALTH AND CARE ANALYTICS
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The Royal Wolverhampton NHS Trust

Walsall Council

Community Diagnostic Centre Planning

A Combined Analytics Approach to Public Access

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Background

Community Diagnostic Centres (CDC) are an important part of delivering key services outside of an acute hospital environment (e.g. CT scans/MRI/X-ray/ultrasound/blood tests), making services more accessible locally and timely for patients. Both the Wolverhampton and Walsall areas lack a CDC site situated within the community, needed to support additional demand from projected population increases and rising prevalence of long-term conditions[1]. A combined approach was undertaken by both Walsall and Wolverhampton's analytical teams, using advanced data analytics, to provide ranked site options for maximising public access and population coverage, including our most deprived[2] communities (core 20, the most deprived 20%), as one key element of a multi-factorial options appraisal.

Criteria

Optimal coverage would be achieved by a maximisation of equally weighted scores:

1. Core 20 Population – Public Transport 20 minutes
2. Core 20 Population – Car Travel 20 minutes
3. Total Population – Public Transport 20 minutes
4. Total Population – Car Travel 20 minutes
5. Equality Ratio – Core 20 Population
6. Equality Ratio – Total Population

Methodology

We developed an R[3] algorithm to analyse SHAPE[4] public access data, across combinations of potential CDC site locations, according to key access criteria: coverage of our total, and the 20% most deprived, resident populations by car or public transport (during rush hour and weekday mornings), and the equality of coverage between Walsall and Wolverhampton (approaching a ratio of 1:1).

The algorithm produced a visualisation for each (*fig. 2-3*), comprising a spine chart (ggplot2[5]) to rank the site combination relative to others, and a map (sf[6]) to visualise site locations and their travel-time isochrone (OSRM[7]) coverage against the core 20 population of both boroughs.

A comprehensive set of 6 site combinations was tested: single sites, paired, and supplementary options. The 136 resultant distinct combinations were distilled into ranking matrices (*fig. 4-5*) to visualise and determine optimal scenarios.

Outcomes

- The model and results challenged the preference for a single site, which provided poorer access options, and allowed for the possibility of a two-site hub and spoke model to be assessed against the other key criteria (including budget, resources and deliverability).
- Modelling had substantial influence upon decision making, particularly in giving appropriate weight to access, rather than only giving highest weight to simplicity of operationalisation (one site option offered a less complex model). This was key to designing our services to meet population need.
- Decision-makers expressed interest in the method for future public health planning.

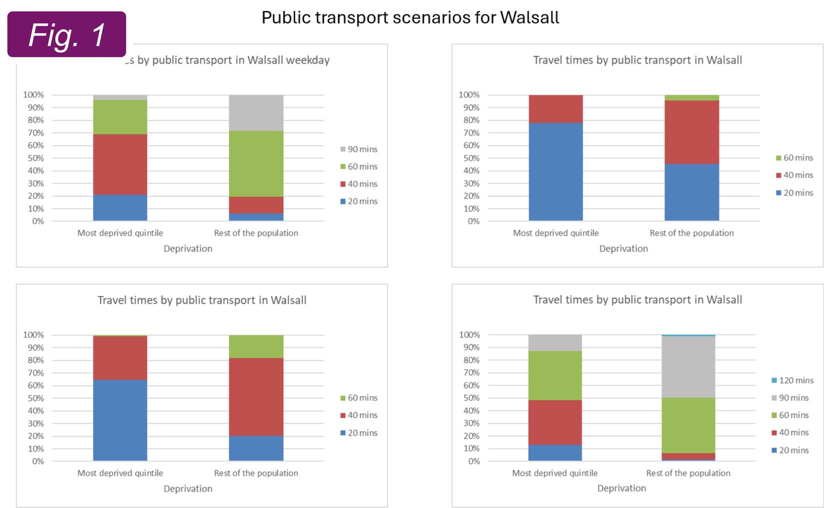
Recommendations

- Whilst intended as a standalone project, the model demonstrated promise and a variety of future applications - we're eager to share it more widely!
- The initial model was an experiment with the idea of testing every possible site combination (breadth), which complimented our parallel analysis of single sites (depth): this combined analytics approach proved to be robust and efficient.
- We have since taken a deeper dive into potential improvements: R libraries such as r5r[8] look incredibly promising, and something we will be investigating for integration into future planning analytics.
- Flexibility could likely be improved with variable access criteria weighting.

Process

1 Initial Data and Site Exploration

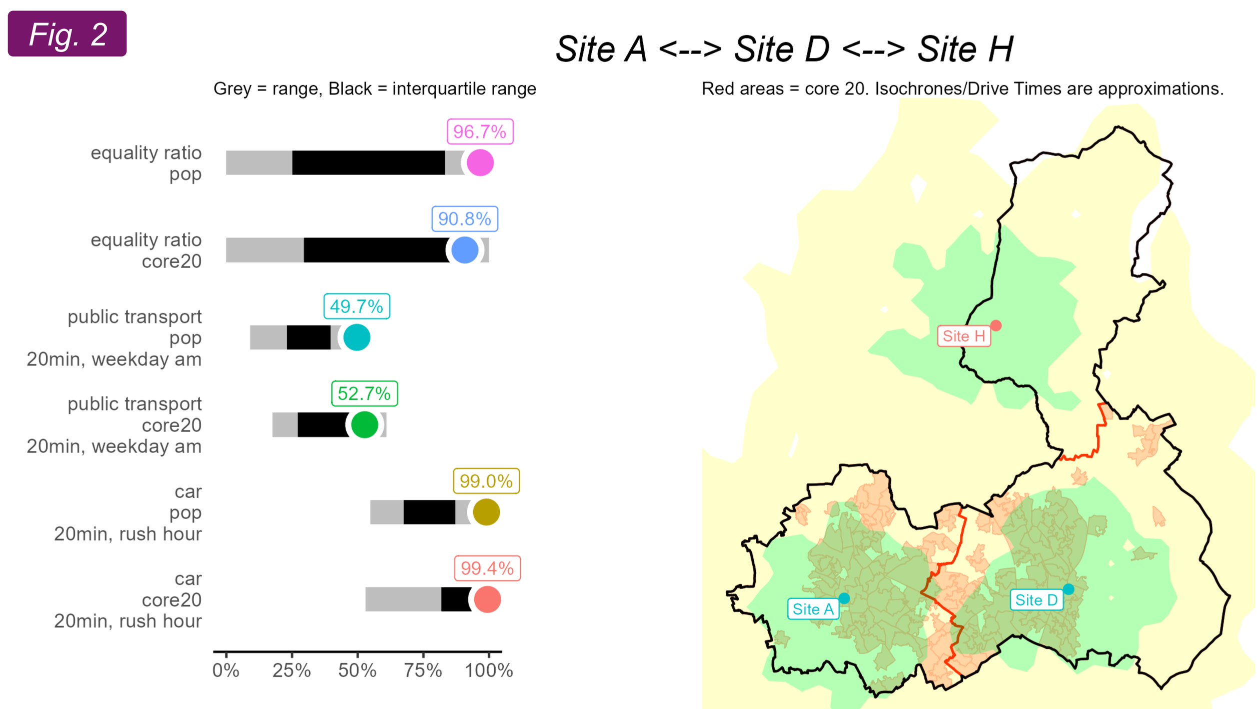
Fig. 1



The initial project began with a few proposed sites; therefore a dedicated assessment was undertaken (depth) with the SHAPE tool and on its extracted data, e.g. travel times for residents to 4 proposed sites (*fig. 1*). However, as more potential sites became plausible, we introduced a breadth approach (analysing all potential combinations), leading to development of an R algorithm.

2 Bespoke R algorithm visualises and analyses every possible site combination

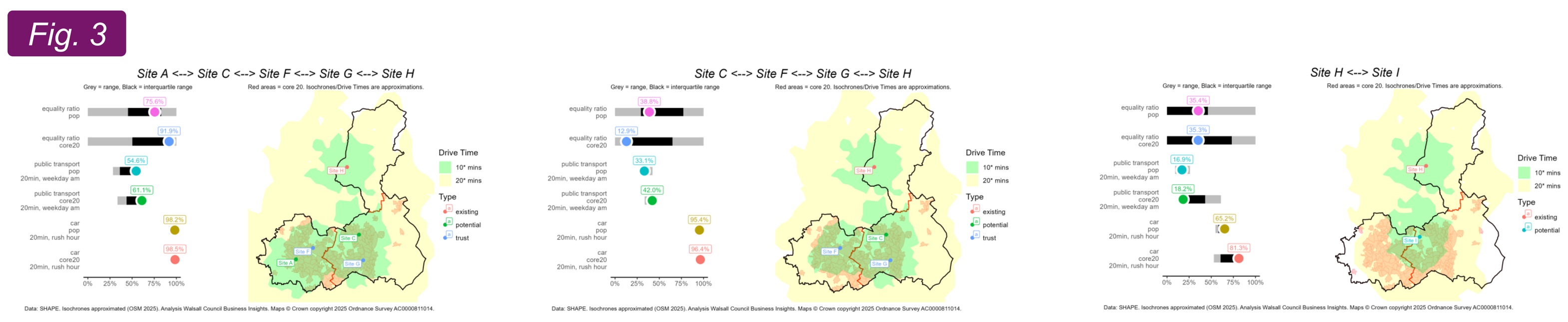
Fig. 2



Data: SHAPE. Isochrones approximated (OSM 2025). Analysis Walsall Council Business Insights. Maps © Crown copyright 2025 Ordnance Survey AC0000811014.

136 distinct site combinations

Fig. 3



3 Ranking matrices produced for each scenario, identifying optimum options

Fig. 4

Site Ranking by Access Score
(Site_H)+2paired_sites+1site

ranking variable

site combinations	car core20	car pop	public core20	public pop	ratio core20	ratio pop
Site H <--> Site A <--> Site E	99.5%	97.6%	58.7%	50.2%	-16.2%	-0.0%
Site H <--> Site A <--> Site D	99.4%	99.0%	52.7%	49.7%	-9.6%	-3.3%
Site H <--> Site A <--> Site C	94.5%	92.8%	44.0%	40.5%	-10.1%	-23.6%
Site H <--> Site B <--> Site I	93.8%	83.6%	39.0%	32.8%	-0.6%	-14.0%
Site H <--> Site B <--> Site C	95.1%	89.7%	41.8%	32.7%	-26.7%	-17.2%
Site H <--> Site J <--> Site E	99.5%	97.8%	41.8%	33.5%	-50.9%	-28.5%
Site H <--> Site A <--> Site I	95.3%	86.6%	44.5%	42.7%	-24.6%	-52.9%
Site H <--> Site J <--> Site D	99.4%	99.3%	35.8%	33.1%	-42.7%	-33.1%
Site H <--> Site B <--> Site E	91.0%	87.3%	56.5%	42.4%	-66.8%	-51.7%
Site H <--> Site A <--> Site M	92.6%	85.9%	47.2%	39.3%	-28.7%	-62.6%
Site H <--> Site B <--> Site D	91.5%	89.5%	50.5%	42.0%	-56.9%	-55.1%
Site H <--> Site J <--> Site I	95.3%	86.6%	27.7%	26.0%	-2.5%	-20.4%
Site H <--> Site J <--> Site C	90.6%	90.6%	27.1%	23.8%	-19.5%	-4.8%
Site H <--> Site K <--> Site M	91.6%	77.9%	38.5%	30.1%	-27.1%	-16.5%
Site H <--> Site J <--> Site M	92.6%	85.9%	30.8%	22.9%	-1.9%	-28.3%
Site H <--> Site K <--> Site L	91.6%	73.9%	28.8%	25.5%	-0.5%	-13.8%
Site H <--> Site B <--> Site M	85.2%	76.6%	34.5%	25.1%	-12.3%	-7.7%
Site H <--> Site B <--> Site L	88.6%	75.4%	35.6%	29.1%	-11.8%	-35.8%
Site H <--> Site A <--> Site L	91.9%	81.8%	45.8%	43.3%	-45.4%	-91.4%
Site H <--> Site J <--> Site L	91.9%	81.8%	30.7%	27.6%	-18.5%	-54.9%
Site H <--> Site L	86.7%	67.9%	22.3%	19.1%	-6.2%	-2.6%
Site H <--> Site K <--> Site E	89.5%	80.2%	48.1%	39.9%	-100.0%	-100.0%
Site H <--> Site K <--> Site I	85.9%	68.8%	23.2%	22.3%	-38.3%	-33.0%
Site H <--> Site K <--> Site D	88.6%	80.7%	44.2%	40.9%	-99.6%	-100.0%
Site H <--> Site K	71.4%	57.5%	18.4%	17.3%	-9.7%	-1.1%
Site H <--> Site B	77.4%	67.4%	24.2%	18.0%	-19.3%	-52.2%
Site H <--> Site K <--> Site C	83.9%	74.3%	32.8%	29.1%	-72.3%	-78.1%
Site H <--> Site I	81.3%	65.2%	18.2%	16.9%	-66.9%	-65.0%
Site H <--> Site E	63.9%	59.5%	60.8%	24.4%	-100.0%	-100.0%
Site H <--> Site M	75.4%	63.6%	21.3%	13.8%	-71.7%	-60.4%
Site H <--> Site A	59.5%	59.2%	56.2%	25.8%	-100.0%	-100.0%
Site H <--> Site D	62.1%	59.2%	49.6%	23.9%	-100.0%	-100.0%
Site H <--> Site C	60.2%	57.8%	17.7%	14.7%	-100.0%	-100.0%
Site H <--> Site J	53.0%	54.9%	20.3%	9.1%	-100.0%	-100.0%

Produced by Walsall Business Insights

Fig. 5

Site Ranking by Access Score
(Site_H)+1site

ranking variable

site combinations	car core20	car pop	public core20	public pop	ratio core20	ratio pop
Site H <--> Site L	86.7%	67.9%	22.3%	19.1%	-6.2%	-2.6%
Site H <--> Site B	77.4%	67.4%	24.2%	18.0%	-19.3%	-52.2%
Site H <--> Site K	71.4%	57.5%	18.4%	17.3%	-9.7%	-1.1%
Site H <--> Site I	81.3%	65.2%	18.2%	16.9%	-66.9%	-65.0%
Site H <--> Site E	63.9%	59.5%	60.8%	24.4%	-100.0%	-100.0%
Site H <--> Site A	59.5%	59.2%	56.2%	25.8%	-100.0%	-100.0%
Site H <--> Site M	75.4%	63.6%	21.3%	13.8%	-71.7%	-60.4%
Site H <--> Site D	62.1%	59.2%	49.6%	23.9%	-100.0%	-100.0%
Site H <--> Site C	60.2%	57.8%	17.7%	14.7%	-100.0%	-100.0%
Site H <--> Site J	53.0%	54.9%	20.3%	9.1%	-100.0%	-100.0%

Produced by Walsall Business Insights

Whilst more sites logically confer greater coverage, limited resources necessitated fewer site combination scenario testing.

4 Inform the decision-making process

Findings contributed to the acknowledgment of public access and preference for a multi-site option for optimal, equitable, public access coverage.

Data: SHAPE. Isochrones (OpenStreetMap 2025). Maps © Crown copyright 2025 Ordnance Survey AC0000811014.

References

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