**Determining optimal locations for urgent care centres in Cornwall using computer modelling**

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**Abstract**

The Sustainability and Transformation Partnership (STP) in Cornwall wanted to identify the optimal number and location of new urgent care centres to be established in the county. These centres would serve to provide a broader range of services than the existing Minor Injury Units, and could help to reduce the number of patients attending Emergency Departments for injuries and conditions that could be dealt with elsewhere.

We developed a computer model that calculated average and maximum travel times, along with number of attendances, for over 4,000 potential urgent care centre geographic configurations. The model predicted that establishing five urgent care centres would largely minimise potential average and maximum travel times for patients across the county. The model also predicted that the locations for these centres that would minimise average travel times would be the acute hospital at Treliske, Bodmin Community Hospital, West Cornwall Hospital, Stratton Community Hospital and Falmouth Community Hospital.

The results from the model were used to directly inform a decision made by the STP in 2018 to establish the first urgent care centres in Cornwall at Treliske, Bodmin Community Hospital and West Cornwall Hospital.

**Introduction**

In 2016, the NHS in England came together with local councils to form a number of Sustainability and Transformation Plans (STPs) (1), now branded Sustainability and Transformation Partnerships (2). These partnerships aimed to plan and develop a more coordinated provision of health and social care services, that seek to implement the vision set out in the Five Year Forward View (1,3). In Cornwall, the STP, branded “Shaping Our Future”, has been developing plans within a number of workstreams, one of which has focused on the development of a sustainable plan for urgent care provision in the county. As part of this, the partnership has been planning to establish a number of urgent care centres across Cornwall that can provide a broader range of services than those currently offered by Minor Injury Units, and help to ease the growing pressures on Emergency Departments (4).

We were asked by the STP to provide external and independent modelling support to help answer two questions. First, how many urgent care centres should there be in Cornwall, and second, where should these urgent care centres be located (amongst the existing estate)? In both cases, the Shaping Our Future team were seeking to ensure that a majority of patients were not required to travel unacceptable distances to access these new centres. The intention was to maximise access to these centres, and promote their use above accessing the Emergency Department in Truro where appropriate.

In this paper, we describe a computer model that used real patient urgent care activity data to calculate the travel times for patients accessing urgent care to each potential combination of urgent care centres. We also describe the key results from this modelling project, and how these results

and the model itself were used to inform key decisions for the establishment of urgent care centres in Cornwall.

**Methods**

Our geographic model was developed using Microsoft Excel (Microsoft Corporation). Potential sites are modelled in terms of their location and their availability, which indicates whether the site hosts an urgent care centre or not in the combination of sites tested. In the model, up to 16 urgent care centre locations are available. These represent the 13 existing sites that offer urgent care services in Cornwall – West Cornwall Hospital, St Austell Community Hospital, Bodmin Community Hospital, Liskeard Community Hospital, Newquay Community Hospital, Camborne and Redruth Community Hospital, Launceston Community Hospital, Helston Community Hospital, Stratton Community Hospital, Falmouth Community Hospital, St Barnabas Community Hospital, Fowey Community Hospital and Royal Cornwall Hospital, Treliske in Truro, along with three sites offering urgent care in Devon (in Plymouth, Tavistock and Okehampton) that may be closer sites for some patients living in Cornwall near the border with Devon, depending on which sites are available in Cornwall. St Mary's Hospital on the Isles of Scilly was excluded from this analysis, as it would be impractical to change the urgent care provision on this island location. Treliske was identified before the project as a site that would house an urgent care centre, due to the existing Emergency Department and its associated auxiliary services being located there. Therefore, Treliske was always available as an urgent care centre in all combinations of sites tested in the model.

In the model, each of the 13 sites in Cornwall is either available or not available as an urgent care centre (with the exception of Treliske, which is always available, as described above). Sites in Devon are always assumed to be available. Patients in the model visit the urgent care centre that is the nearest available to their home address. The model necessarily assumes that patients are at or close to home when they need to access urgent care. This may not be true in all cases (as patients may be at work or visiting another location). Data was not available to identify the precise location of patients when they needed to access urgent care, but the data did show that 55% of patients were at home when the incident occurred, compared with around 9% who were at work, and around 18% who were described as being in a "public place". The model also assumes that patients travel to an urgent care centre by motorised vehicle (car, ambulance etc) rather than walking or by public transport. The data shows that 90% of patients arrive by car or ambulance, compared to only 1% who arrive by public transport.

Three years of pseudo-anonymised urgent care activity data was used to model the level of urgent care activity from each postcode sector in the model, covering the period from 5$^{th}$ August 2013 to 4$^{th}$ August 2016. Data included the date of attendance, the site the patient attended and the home postcode sector of the patient. In addition, data from Treliske and West Cornwall hospitals included mode of travel to the site and the category of location where the incident happened, which allowed us to validate the assumptions described above. In all, the data covered 365,578 records across the 13 urgent care sites in Cornwall, and covered 96% of postcode sectors across Cornwall. The remaining 4% of postcode sectors that were not represented in the data all had neighbouring postcode sectors represented, minimising the risk of identifying optimal configurations that would be poor choices for patients in these postcode sectors. Travel distances and times from the centre of each postcode sector in the data to each of the 13 urgent care sites was calculated using Microsoft MapPoint software (Microsoft Corporation) with the MPMileCharter extension (Winwaed Software Technology LLC).

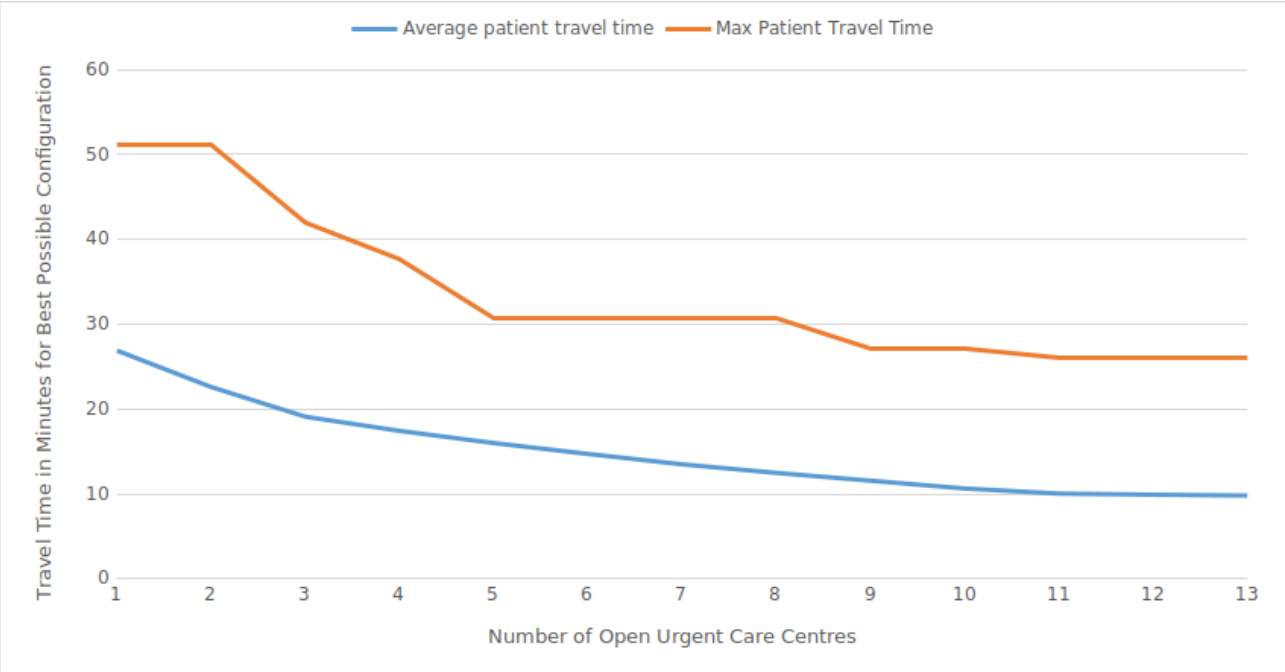
We used the model to test all 4,096 possible combination of available urgent care centres (assuming that Treliske and the three sites in Devon are always available). Visual Basic for Applications (VBA) was used to automate the process of testing each configuration. For each scenario, the

model calculates the predicted number of attendances per year for each site, along with mean, maximum and 99th percentile travel times to patients' nearest available urgent care centre. Averages are calculated as weighted averages, with average travel times from each postcode sector weighted by the amount of urgent care activity coming from that postcode sector. In this way, postcode sectors with higher levels of urgent care activity are represented more substantially in the average calculation.

An Excel-based tool was developed to allow the collaborators within the STP to explore the results from the 4,096 scenarios in a meaningful way. Specifically, the tool allowed the user to specify different combinations of urgent care centre availability, with the corresponding results being called up, along with a comparison to the scenario of having an urgent care centre available at every possible site. This allowed the users to explore potential combination of sites that may not strictly be "optimal" in terms of having the lowest average and / or maximum travel times, but which may be better choices for other reasons not captured by the model, such as feasibility of the site to host an urgent care centre.

**Results**

For each potential number of urgent care centres in Cornwall (from a minimum of 1 to a maximum of 13), we plotted the average and maximum travel times from the scenario that gave the lowest average travel time for that number of available centres (Figure 1). The model predicts that, with just one urgent care centre in Cornwall (at Treliske), average travel time for patients would be around 27 minutes, but some patients would have a travel time of around 51 minutes. With 13 urgent care centres (one at every existing site), average patient travel time would reduce to around 10 minutes, and maximum travel time to around 26 minutes. Findings from the model indicated that an increase in the number of urgent care centres from one to ten would significantly reduce average patient travel time. However, travel time benefits started to diminish when more than 10 urgent care centres were modelled. In terms of maximum travel times, significant reductions can be observed until around 5 centres are in place, at which point there are significantly diminished returns from having any more centres.




The model predicts the following locations for urgent care centres would lead to the lowest average patient travel time for each number of urgent care centres being available :

- 2 centres – Treliske and Bodmin
- 3 centres – as above, plus West Cornwall
- 4 centres – as above, plus Stratton
- 5 centres – as above, plus Falmouth
- 6 centres – as above, plus St Austell
- 7 centres – as above, plus Camborne and Redruth
- 8 centres – as above, plus Liskeard
- 9 centres – as above, plus Helston
- 10 centres – as above, plus Newquay
- 11 centres – as above, plus Launceston
- 12 centres – as above, plus Fowey
- 13 centres – as above, plus St Barnabas

By predicting the number of attendances per year at each site for each scenario, the practicability of using the existing estate at each site for an urgent care centre can be assessed. The model predicts that, for the scenario that minimises average travel times for each number of urgent care centres being available, the number of attendances per year at each site (assuming that all existing activity could be seen at an urgent care centre) would be as follows :

- 2 centres – Treliske (65,659) and Bodmin (37,387)
- 3 centres – Treliske (42,721), Bodmin (37,387) and West Cornwall (22,938)
- 4 centres – Treliske (42,721), Bodmin (35,219), West Cornwall (22,938) and Stratton (9,882)
- 5 centres – Treliske (30,084), Bodmin (35,219), West Cornwall (17,270), Stratton (9,882) and Falmouth (18,305)
- 6 centres – Treliske (28,398), Bodmin (20,265), West Cornwall (17,270), Stratton (9,882), Falmouth (18,305) and St Austell (16,640)
- 7 centres – Treliske (12,146), Bodmin (20,265), West Cornwall (16,348), Stratton (9,882), Falmouth (12,425), St Austell (16,640) and Camborne and Redruth (23,054)
- 8 centres – Treliske (12,146), Bodmin (14,456), West Cornwall (16,348), Stratton (9,882), Falmouth (12,425), St Austell (16,640), Camborne and Redruth (23,054) and Liskeard (12,381)
- 9 centres – Treliske (12,146), Bodmin (14,456), West Cornwall (14,327), Stratton (9,882), Falmouth (10,650), St Austell (16,640), Camborne and Redruth (18,311), Liskeard (12,381) and Helston (8,538)
- 10 centres – Treliske (6,568), Bodmin (10,248), West Cornwall (14,327), Stratton (9,882), Falmouth (10,650), St Austell (16,640), Camborne and Redruth (18,311), Liskeard (12,381), Helston (8,538) and Newquay (9,786)
- 11 centres – Treliske (6,568), Bodmin (10,248), West Cornwall (14,327), Stratton (6,500), Falmouth (10,650), St Austell (16,640), Camborne and Redruth (18,311), Liskeard (10,509), Helston (8,538), Newquay (9,786) and Launceston (7,878)
- 12 centres – Treliske (6,568), Bodmin (10,248), West Cornwall (14,327), Stratton (6,500), Falmouth (10,650), St Austell (13,575), Camborne and Redruth (18,311), Liskeard (9,102), Helston (8,538), Newquay (9,786), Launceston (7,878) and Fowey (4,472)
- 13 centres – Treliske (6,568), Bodmin (10,248), West Cornwall (14,327), Stratton (6,500), Falmouth (10,650), St Austell (13,575), Camborne and Redruth (18,311), Liskeard (8,415), Helston (8,538), Newquay (9,786), Launceston (7,878), Fowey (4,472) and St Barnabas (1,581)

The model also predicts that, if there were two or three urgent care centres in Cornwall, around 18,813 attendances per year would be seen in Devon from patients in Cornwall, which represents

around 15% of urgent care activity from patients living in Cornwall. For between four and seven urgent care centres, this would fall to around 11,099 attendances per year (9%); for between eight and 10 urgent care centres, this would further reduce to around 4,526 attendances per year (3.7%); for 11 or 12 centres, this would reduce to around 1,903 attendances per year (1.6%), and if all 13 sites had urgent care centres this would reduce to around 1,009 attendances per year (0.8%).

**Discussion**

The predictions from the model suggest that there is limited benefit in having more than around five to eight urgent care centres in Cornwall, at least in terms of minimising average and maximum patient travel times. Indeed, maximum travel times can be largely minimised by having just five urgent care centres, at Treliske, Bodmin, West Cornwall, Stratton and Falmouth. Such a configuration should result in the average patient being within around 16 minutes of an urgent care centre, and no patient travelling more than around 31 minutes.

Thought would need to be given to whether the identified sites could practically handle potentially larger volumes of patients accessing an urgent care centre there. In particular, in the five centre configuration described above (and, indeed, across many of the optimal configurations identified), Bodmin Community Hospital could see a significant increase in attendances if an urgent care centre was located there. Of course, our calculations assume that all urgent care activity could be handled by the newly proposed urgent care centres, which will not be the case as there will still be injuries and conditions that can only be handled by an Emergency Department. However, if the intention is for the new urgent care centres to divert a non-trivial amount of urgent care activity away from the Emergency Department, then careful consideration needs to be given to if and how the identified sites can accommodate (potentially significantly) larger volumes of activity. This may not be practical in some cases, and so the model alone could offer misleading recommendations unless these external factors were factored in to any decision making.

It should also be noted that, in many cases, the difference between the “optimal” configuration identified by the model (in terms of being the one that would lead to the lowest average travel time), and the second, third, fourth (and beyond) “best” configurations is trivial. For example, there is less than a 20 second difference in predicted travel time between the “optimal” and “fifth best” options for a five centre configuration (although the difference in maximum travel time is more significant, with around a 7 minute difference). This tell us two things – first, the average travel time results should not be considered in isolation, but rather alongside the impact on travel times for the patients travelling furthest. Second, the model suggests that there are a number of “optimal” scenarios for each number of urgent care centres that are as good as each other, and any decision making should also consider external aspects for choice of site (such as practicality of development of the site). Therefore, the Excel-based tool for exploring all of the results is an important decision-support aid here, and it is important that the “optimal” results predicted by the model are not considered in isolation.

Our model assumes that patients typically travel to the nearest available urgent care centre to their home address, and that they travel via car, taxi or ambulance rather than by public transport or walking. Data held by the trust indicated that around 90% of people arrive to the Emergency Department at Treliske by car, taxi or ambulance, but data was unavailable for travel the other sites. Therefore, it is possible that our model underestimates travel times for patients to other centres if they commonly use other modes of transport. However, given we are exclusively looking at patients accessing urgent care, it is unlikely that most patients in need of urgent care would use public transport. The data also indicated that 45% of patients attending Treliske were not at home when the incident that led to them needing to access urgent care occurred. Unfortunately, data is not currently available to more precisely indicate the location of patients when incidents occur, but such data could help to improve this aspect of the modelling.

In 2018, the STP made a decision about the locations for establishing the first urgent care centres in Cornwall (5), supported by the evidence from this project. Specifically, they announced that they would establish three urgent care centres, to be located at Treliske, Bodmin Community Hospital and West Cornwall Hospital – the optimal configuration of three urgent care centres identified by our model. Our model predicts that this will lead to the average patient being within around 19 minutes of an urgent care centre, with the most distant patients travelling around 42 minutes.

The geographic modelling methods described in this paper can be powerful decision support tools for health service planning (6–8). We would encourage other STPs across England to engage with such methods to help provide evidence to support their system-level decision making.

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