HSD114

Reductions in Travel Time and Carbon Dioxide Emissions Arising from Patient Transportation to Hospitals in England for Treatment with Intravenous Iron: An Analysis Comparing Ferric Derisomaltose with Ferric Carboxymaltose

Ahmed W[1], Pöhlmann J[1], Brewerton S[2], Sørensen J[3], Nottmeier M[3], Rethmeier LO[3], Pollock RF[1]

[1] Covalence Research Ltd, Harpenden, UK [2] Pharmacosmos UK Ltd, Reading, UK [3] Pharmacosmos A/S, Holbæk, Denmark

Background

Reducing the number of unnecessary patient interactions with the healthcare system — particularly hospital appointments — has myriad benefits, including reducing demand for constrained resources (staff time, equipment, and facilities), reducing the risk of exposure to nosocomial infections, reducing patient inconvenience, travel time and travel-related carbon dioxide (CO_2) emissions, while also improving patient quality of life.[1]

Attempts to minimize unnecessary patient interactions often comprise large-scale organizational changes to the healthcare system, such as closer integration of health and social care, integration of primary and secondary care, increasing adoption of telemedicine, and implementation of "hospital-at-home" schemes.[1] However, particulary in the case of outpatient appointments and elective admissions, reductions in patient interactions can also be achieved more economically through formulary management.

One example where formulary decisions can affect the number of patient interactions with the healthcare system can be found in iron deficiency anemia (IDA). Intravenous (IV) iron is the preferred treatment for patients with IDA requiring rapid iron replenishment, or in whom oral iron is contraindicated, not tolerated, or ineffective. Two high-dose, rapid-infusion IV iron formulations are available in the UK: ferric derisomaltose (FDI) and ferric carboxymaltose (FCM). The two formulations differ in their approved posology; a single administration of FCM should not exceed 1,000 mg or 20 mg/kg bodyweight (whichever is lower),[2] while FDI has a limit of 20 mg/kg bodyweight per infusion without other restrictions.[3] This can have the effect of increasing the number of FCM infusions required in patients with a calculated iron need greater than 1,000 mg.[4] Greater numbers of infusions are associated with more hospital appointments, greater distances traveled, and increased CO_2 emissions from patient travel.

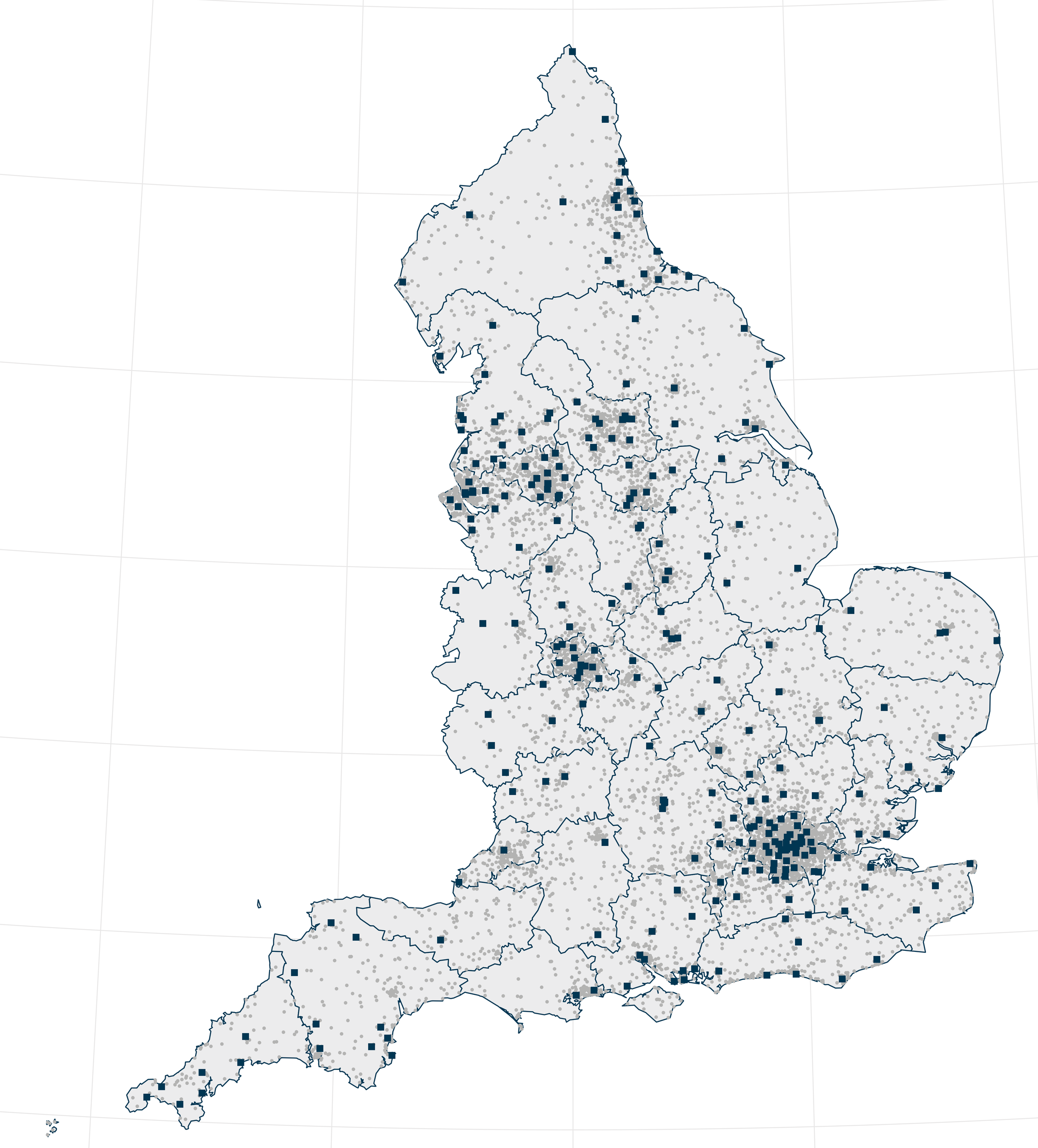
The aim of the present study was to quantify the effect of these differences on patient travel time and distance, and annual CO_2 emissions in the IDA population in England.

Methods

A multi-modality patient transportation model was developed in Python and validated in R. The model was designed to estimate the distance traveled, time spent traveling, and travel-related CO_2 emissions arising from patients with IDA traveling to the nearest hospital in which IV iron is administered. Fundamentally, the model was based on population-weighted calculations of the mean distance from each English postcode district to the nearest hospital at which IV iron is administered.

Population data for English postcode districts were obtained from the 2021 census, published by the Office of National Statistics. Non-geographic postcodes (e.g., those beginning with 'BX') were excluded before the final analyses were conducted, ultimately leaving 8,015 postcode districts for analysis (Figure 1).

Figure 1. Geographical data underpinning the English transportation model



Blue squares represent hospitals where IV iron is administered, gray dots represent the centroids of each English postcode district, and the blue boundaries (for information only) are the boundaries of the 42 integrated care systems introduced under The Health and Care Act 2022.

Table 1. Annual projections of distance traveled, time spent traveling, and CO2 emissions arising from trips to the hospital for intravenous iron infusions in England

Treatment	Travel distance (million km)	Travel time (hours)	CO_2 emissions from patient travel (kg)
Ferric carboxymaltose	4.31	89,048	769,799
Ferric derisomaltose	3.28	67,918	587,135
Difference with ferric derisomaltose	**-1.02**	**-21,130**	**-182,664**

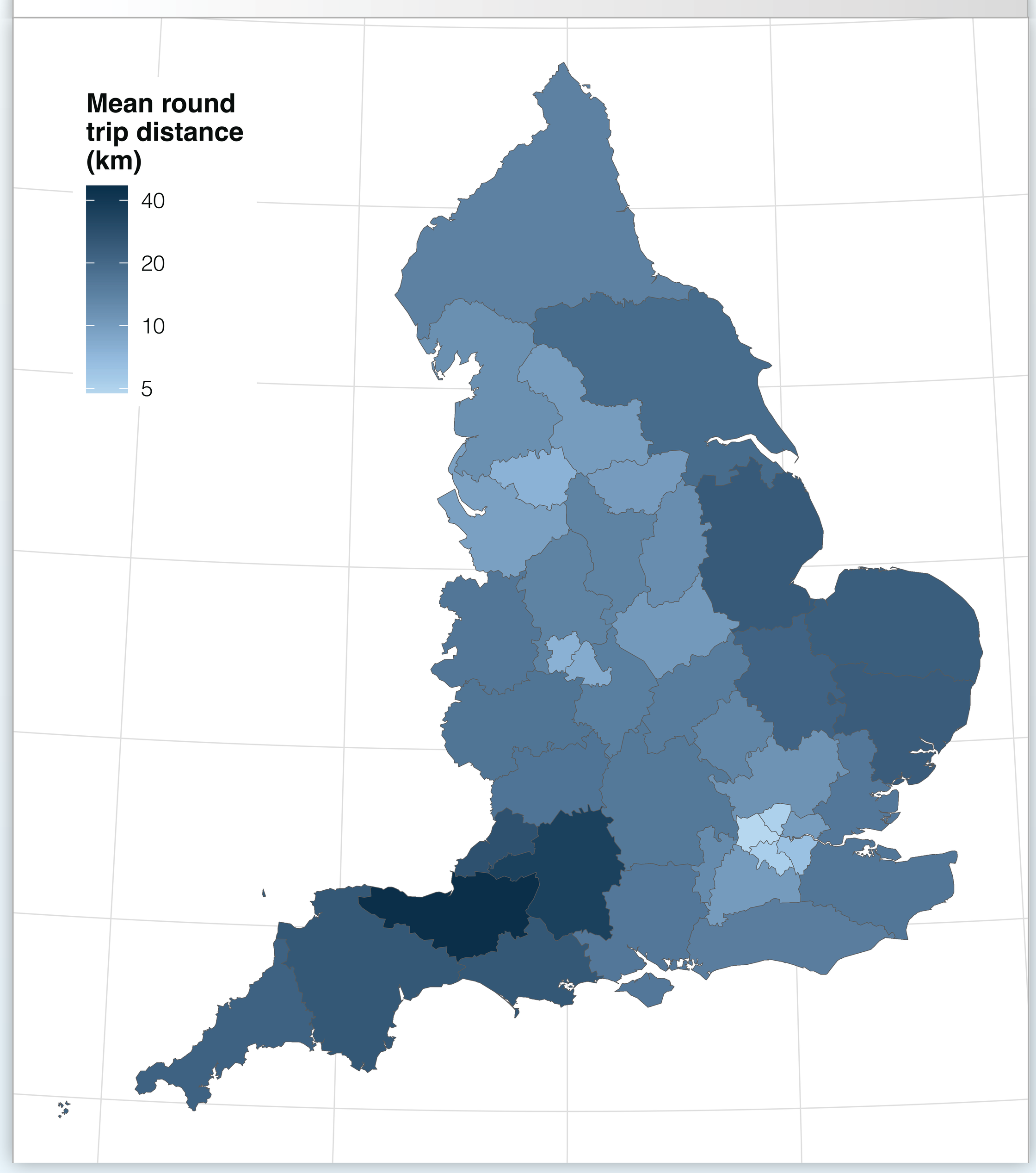
A list of English hospitals administering IV iron was obtained from the IQVIA Hospital Profiler database (Figure 1). The mean distance from the centroid of each postcode district to the nearest hospital was then calculated, weighted by the postcode district population, and adjusted using a "detour index" to account for deviations from the straight-line distance between the postcode district centroids and the nearest hospital.

Transport modality and CO_2 emissions data by mode of transport were then obtained from UK Government sources. Data from the Department for Transport, and specifically from the National Travel Survey, were used to model the utilisation of different transport modalities. Based on these sources, 76.1% of patients travelled to their nearest hospital by car, 3.9% of patients by bus, 2.8% of patients by train, and 1.0% of patients by taxi. The remaining two patient groups used either undefined CO_2-emitting modes of transport (1.6%) or non-CO_2 emitting modes of transport such as walking or cycling (14.6%) and were omitted from the CO_2 analysis.

CO_2 emissions data for each mode of transport were obtained from the UK Department for Business, Energy & Industrial Strategy in grams per passenger kilometre, specifically 192 g/km, 149 g/km, 104 g/km and 41 g/km for cars, taxis, buses, and trains, respectively.

The mean number of infusions of FCM versus FDI was calculated using a published and validated methodology.[5] Iron need was calculated using a simplified table of iron need and patient characteristics were based on data from seven IDA trials (mean bodyweight of 82.4 kg [SD 22.5 kg] and hemoglobin levels of 9.99 g/dL [SD 1.03 g/dL]). The number of infusions was then combined with annual estimates of patients receiving IV iron treatment, and layered onto the underlying transport model to calculate changes in patient travel time, distance, and CO_2 emissions associated with using exclusively FDI versus exclusively FCM.

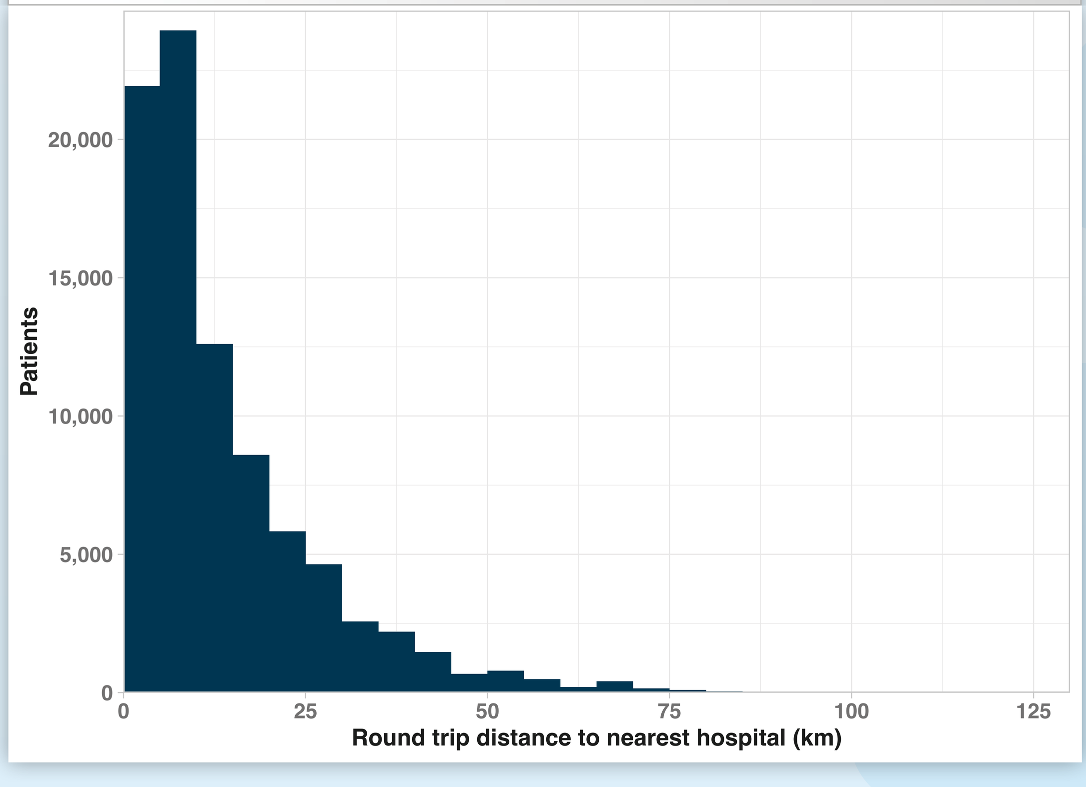
Figure 3. Integrated Care Systems shaded by mean round-trip distance to the nearest hospital administering intravenous iron



Results

The UK IDA population currently receiving IV iron therapy was estimated to be 86,640 *per annum* and the base case analysis was conducted based on one IV iron treatment course per patient. The average travel distance to the nearest hospital across all English postcode districts was 9.5 km (18.9 km per round trip; Figure 2).

Figure 2. Number of patients by the estimated round-trip distance to the nearest hospital administering intravenous iron



Patients in the TR22 postcode district (Isles of Scilly) had the longest travel distance to the nearest hospital, at 71.2 km. At the Integrated Care System (ICS) level, patients in the NHS Somerset ICS had the furthest average distance to travel (46.9 km), while patients in the NHS North West London ICS had the shortest (4.8 km; Figure 3).

FDI would reduce the mean number of iron infusions per treatment course by 0.42 from 1.77 to 1.35 (23.7%) relative to FCM. Based on the multi-modality model of transport to English hospitals administering IV iron, FDI was projected to reduce the annual distance travelled by 1,021,675 km from 4,305,621 km to 3,283,946 km relative to FCM, saving 21,130 hours of patient time and reducing CO_2 emissions by 182,664 kg (Table 1).

Conclusion

- Compared with FCM, FDI reduced the number of IV infusions required, resulting in associated reductions in patient travel time, distance, and CO_2 emissions in patients with IDA in England.

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