Appendix A: Detailed Network Analysis Algorithm

Our travel-burden analysis used the Valhalla routing engine, an open-source road-network analysis platform that provides turn-by-turn directions and respects traffic laws and speed limits (1). To evaluate Valhalla's performance, for a small sample of trips we compared Valhalla's predictions to simple distance calculations along Statistics Canada's road networks and to distance and time predictions using Google Maps' online service. We found that Valhalla provided realistic routes and reliable travel-time estimates. Driving travel burden was measured as time in minutes, and walking travel burden was measured as distance in kilometres. Our driving and walking analyses used Valhalla's "auto" and "pedestrian" costing methods respectively, which means that, for example, driving trips prioritized highways and avoided walking paths, and walking trips prioritized streets with sidewalks and avoided highways. Time of day and traffic were not considered, and it was assumed that vehicles travel the speed limit for the entire trip. Road network data was obtained from OpenStreetMap (2). All analysis was done using the open-source statistical software packages R (3) and RStudio (4), with the interface to Valhalla through the R package **valhallr** (5).

Our walking and driving travel-burden analyses both followed the same four steps:

- First, we calculated the travel burden for each of Ottawa's 8,086 dissemination blocks (DBs) to each applicable family physician. For the general population we used all family physicians, and for French-only-speakers we used the subset of French-speaking family physicians.
- Second, for each DB we found the average distance and time of the five shortest trips. In our sensitivity analyses, we performed this calculation for the nearest 1 to 10 physicians inclusively.
- Third, we determined the applicable DB-level population. For the general population we used the 2016 census population. For French-only-speakers we weighted each DB's 2016 census population by the dissemination-area (DA) level percentage of residents who reported speaking French but not English in the 2016 census (6), assuming an even distribution of language proficiency across the DA. While this assumption is an approximation, it is necessary since language ability is only available at the DA level.
- Fourth, we used population-weighted averaging to calculate 108 neighbourhood-level travel burdens from the DB-level metrics. This method assigns more weight to more populated areas and is an attempt to reflect the "average" resident's lived experience in each neighbourhood. Each DB was assigned to the populated neighbourhood it overlapped the most.

The result is a set of neighbourhood-level average distances and times to primary care, via walking and driving, for the general population to any family physician and for French-only-speakers to French-speaking family physicians.

Note on Neighbourhood boundaries: Ottawa Neighbourhood Study (ONS) neighbourhood boundaries are constructed in consultation with community members and are intended to

reflect residents' own views of their communities. Dissemination block (DB) boundaries are set by Statistics Canada based on road networks. These two boundary sets are constructed using different methodologies, and they align in some but not all cases.

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