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Evaluating spatiotemporal modal accessibility to community pharmacy services in Lisbon municipality

Cláudia M. Viana*, Jorge Rocha*, David S. Vale**

*Centre for Geographical Studies, Laboratório Associado TERRA, Institute of Geography and Territorial Planning, University of Lisbon, Portugal.

**CIAUD, Lisbon School of Architecture, University of Lisbon, Portugal.

INTRODUCTION

There are several studies on accessibility to community pharmacy services, emphasizing it as an important element to help address public health and to promote the well-being of the population by providing a very broad array of pharmaceutical services. However, the majority focuses on pedestrian and/or car geographical accessibility, somehow ignoring both the temporal inequity and the influence of the choice of transportation mode. In this paper, **we present both spatial and temporal accessibility perspectives to community pharmacy services considering five periods depicting the operational hours of the facilities, and two different travel modes - walking and public transport (PT).** In addition, a disparity index is calculated to understand the influence that the transport mode exerts on accessibility to the facilities.

DATA & METHODS

Accessibility measure

Accessibility was measured by calculating the number of community pharmacy services reached from a hexagon centroid (n = 1120) within a 10-minute maximum travel time and considering two different modes; and was estimated based on an origin destination (OD) matrix for five different day times (4 to 5 AM, 8 to 9 AM, 1 to 2 PM, 6 to 7 PM, 11 to 12 PM) (Figure 1).

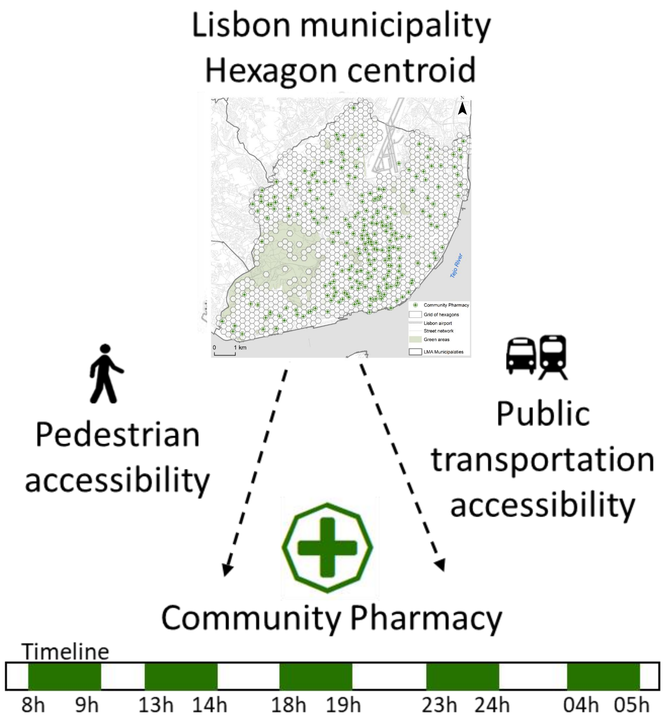

Figure 1. Study framework

PT travel times were calculated using GTFS (General Transit Feed Specification) data from the city's open data portal. Pedestrian travel time was based on "Walking Time" considering the ArcGIS Pro Online network analysis service street network. Specific information regarding pharmacies operational hours was completed using Google Maps Places API, a service that returns information about places using HTTP requests.

ACCESSIBILITY DISPARITY INDICATOR

Disparity was calculated as a gap, which varies between -1 and 1, where 0 means parity. To evaluate the multimodal disparity of access community pharmacy a ratio or dissimilarity indicators can be calculated. Given the greater ease of interpretation of the accessibility gap.

$$AD_{ipq} = AG_{ipq} = \frac{A_i^p - A_i^q}{A_i^p + A_i^q}$$

Where AD_{ipq} is the accessibility disparity of place i beatween modes p and q, AG_{ipq} is the accessibility gap of place i, A_i^p is the accessibility of place i considering the travel mode p, and A_i^q is the accessibility of place i considering the travel mode q.

RESULTS AND DISCUSSION

Travel mode has a clear impact on the accessibility to pharmacies (Table 1). In general terms, travelling by PT increases accessibility when compared to walking for all the five-day times (Figure 2 and 3). By PT, higher differences were observed when comparing to walking accessibility during 8-9 AM and 11-12 PM. Greater accessibility was observed in the afternoon's periods in both modes, as there more than 80% of the territory has access to at least one pharmacy. In terms of the mean of number of services accessed, the results show that between 11-12 PM and 4-5 AM for both modes the average number of accessible pharmacies is less than 1.

	Walk (%)	PT (%)	Walk-PT Difference (%)	Walk (Mean)	PT (Mean)
8-9 AM	54.2	76.3	**-22.1**	1.7	5.3
1-2 PM	79.8	90.8	-11	3.8	9.4
6-7 PM	83.3	92.7	-9.4	4.0	10.2
11-12 PM	20.5	40.5	**-20**	0.3	0.8
4-5 AM	8.9	16.1	-7.2	0.1	0.3

Table 1. Percentage of centroids that reached one community pharmacy service within 10 minutes' travel time and average number of accessed pharmacies.

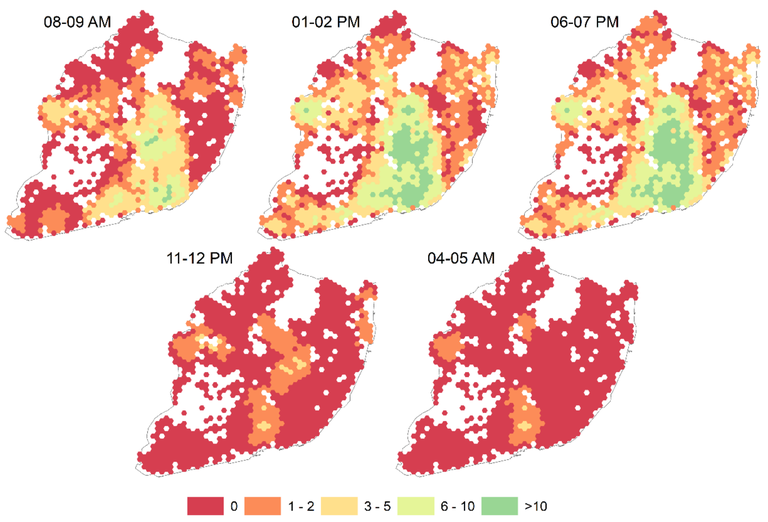

Figure 2. Number of community pharmacies within 10 minutes **pedestrian** travel distance for each daytime

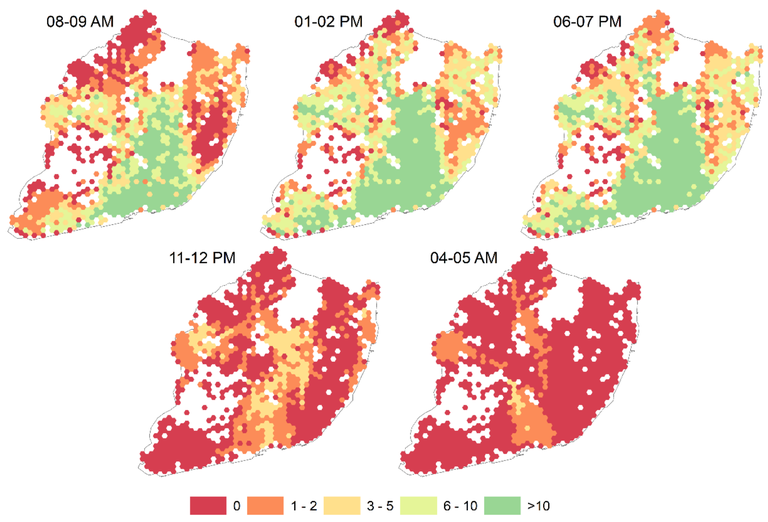

Figure 3. Number of community pharmacies within 10 minutes **PT** travel distance for each daytime

The higher disparities were observed for the period 11-12PM (gap=0.60) and 8-9AM (gap=0.56). Although TP travel also increases the accessibility to pharmacies when compared to pedestrian the lowest disparity observed was for both periods 1-2PM and 6-7PM (Figure 4). Mostly explained by the pharmacy operational hours.

Results emphasize **the importance of considering different travel modes to measure health care accessibility.** Calculating multimodal accessibility can improve the overall evaluation of healthcare accessibility, which can be improved either by increasing the PT supply or by locating new healthcare facilities in places with higher disparity.

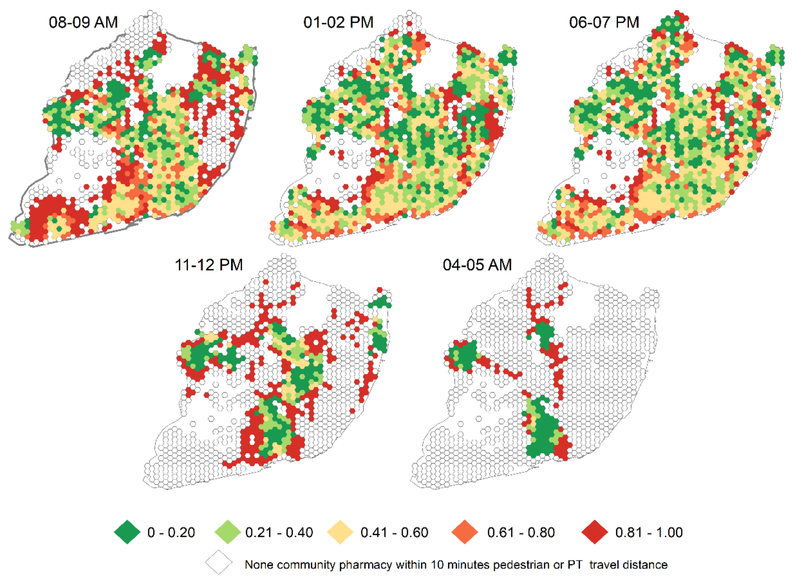

Figure 4. Spatiotemporal disparity accessibility for each daytime

CEG IGOT Instituto de Geografia e Ordenamento do Território UNIVERSIDADE DE LISBOA U LISBOA UNIVERSIDADE DE LISBOA FCT Fundação para a Ciência e a Tecnologia MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR UIDP/00295/2020 CiAUD Centro de Investigação em Arquitetura, Urbanismo e Design FACULDADE DE ARQUITETURA UNIVERSIDADE DE LISBOA