Dynamic geographical accessibility assessments to improve health equity: protocol for a test case in Cali, Colombia

[Evaluaciones dinámicas de accesibilidad geográfica para mejorar la equidad: prueba en Cali, Colombia: protocolo de investigación]
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Electronic copy available at: https://ssrn.com/abstract=4175407
Administrative information

Ethics Committee Registration: This health services quality improvement protocol uses anonymized coded secondary data sources from publicly available open records and does not include human subjects’ research.

Protocol version: 5.6.1

MeSH-keywords: Health Services Accessibility; City Planning; Urban Health; Health inequality monitoring; Spatial analysis; Residence characteristics; Spatial distribution, population; Accessibility, Health Services; Health Services Geographic Accessibility; Health Services Research; Health services Evaluation

Funding: Unfunded Ph.D. work with the Universitat Autònoma de Barcelona. Duties and responsibilities:

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Electronic copy available at: https://ssrn.com/abstract=4175407
Summary

This protocol proposes an approach to assessing the place of residence as a spatial determinant of health in cities where traffic congestion might impact health services accessibility. The study will explore the use of dynamic travel times, instead of traveled distance, to inform urban and health services planning and evaluation. It aims to present data in ways that help shape decisions and spur action by diverse stakeholders and sectors.

Equity assessments in geographical accessibility to health services typically rely on static metrics, such as distance or average travel times. This protocol explores a new approach to assess equity by using dynamic travel times from residence to the location of the relevant health service with the shortest travel time journey. The study results will show the interplay between traffic congestion, accessibility, and health equity and should be used to inform urban and health services monitoring and planning.

Datafication, digitization, and data sciences enable affordable assessments of accessibility to health services while offering adequate accuracy and efficiency for urban and health services monitoring and planning. This can be done by applying data analytics to publicly available sources that describe populations, health services, and travel times to assess accessibility from an equity perspective. Dynamic assessments consider variations in urban traffic and their effect on travel times, equity, and accessibility.

This research aims to (1) provide dynamic measurements of travel times to selected health services used for urgent or frequent care (i.e., repeated ambulatory care). Cross-sectional assessments will study accessibility and equity for the studied health services in the entire city; (2) assess potential improvements from optimizing the location of up to two new health services representing urgent care and frequent care scenarios; (3) provide insights and recommendations for future studies exploring their value in reframing healthy urbanism and health services planning in response to new knowledge.

This study will use visualizations and descriptive statistics to allow non-specialized stakeholders to understand the effects of accessibility on populations and health equity. For this, the study will use well-established metrics, such as “time-to-destination,” or the proportion of the people that can reach a service within a given travel time threshold from the place of residence. These times will be estimated for travel by car (private or for hire) for this demonstration.

The study is part of the AMORE Collaborative Project, in which a diverse group of stakeholders seeks to address equity for accessibility to essential health services. The Collaborative Project
involves the participation of over two dozen contributors representing health service users and providers, authorities, and community members, including academia.

**Introduction**

Equitable accessibility is central to the United Nations Sustainable Development Goals and targets like universal health coverage and quality of care. A common definition of accessibility is the relative ease (travel time by car) by which a destination (health service) can be reached from a given location (residence). Equity assessments in geographical accessibility to health services typically rely on static metrics, such as distance or average travel times.

Measuring equitable accessibility has several challenges. Accessibility studies assess distance or the shortest average travel time to the nearest facility; they seldom assess equity and are typically geared towards field experts. These studies usually explore broad service categories without focusing on specific services people might need. They are lengthy, costly, and rarely address the dynamic temporospatial nature of accessibility, such as its links to traffic congestion.

Reliable data on equity of accessibility to urban health services has been elusive for most cities due to limitations in sampling techniques, extrapolations, and the use of complex methods to capture temporospatial variations associated with traffic congestion. Stakeholders, including urban and health service planners, have relied on indirect fixed assessments that fail to address the impact of traffic congestion on equity.

These challenges were understandable because assessments were cumbersome and required detailed origin-destination studies with small samples from home surveys, traffic corridor speed cameras, or extrapolations from average traffic in selected corridors, with limited intersectoral and multistakeholder participation. Results would turn irrelevant given the rapid changes in conditions, including traffic congestion, populations, or infrastructure.

Travel times affect geographic accessibility and the quality of care. Poor accessibility can lead the most socially disadvantaged populations to pay the highest share to reach health services, an aberration of social justice known as the “inverse care law.” Lengthy travel times hurt people; they are detrimental to health, well-being, and family finances. Measuring travel times might reveal problems hiding in plain sight. Addressing accessibility might help people unable to choose a better place of residence overcome structural barriers to health.

Travel time assessments have been widely available for commodities and commerce and powered consumer apps. These developments have yet to translate into a systematic integration of dynamic equity assessments into urban and health services planning or public sector debates about land use and how to put health services within reach of the broadest population possible.

Measurements have proven difficult, and this project explores a new approach to making measurements feasible, scalable, and adaptable to urban sprawl and lengthening journeys. This new line of research explores if market forces and land use plans achieve service accessibility and if this holds for populations in situations of vulnerability.
The Need for This Study

This proposal spurs the scaling up and replicating of accessibility analyses to health services in urban centers while promoting accessibility indicators based on dynamic travel times. The research demystifies the use of big data and analytics that reveal the needs of citizens, including the most vulnerable. The project will lay the basis for subsequent studies that assess the value and use of dynamic accessibility and equity assessments in urban and health services planning.

This project explores a new approach to making such measurements feasible, scalable, and adaptable to urban sprawl and long journeys. This new line of research examines whether market forces and land use planning achieve services’ accessibility and if this holds for populations in situations of vulnerability.

Using reliable data that is systematically updated and publicly available could be a game-changer. This study tests a new approach for assessing dynamic accessibility to health services, providing an equity perspective and using digital data sources.

Using data readily available in the public domain allows these assessments to be completed in a shorter time and with a lower budget. When combined, the growing millions of measurements of travel times (big data) passively collected by mobile apps, the digitalized georeferenced sociodemographic data from the census, and the geolocation of health services, provide a dynamic assessment of accessibility that accounts for temporospatial variations related to traffic congestion. Big data provides millions of measurements that allow identifying unexpected correlations with a level of detail and accuracy that surveys and inferences cannot match.

This study aims to overcome the limitations of regular accessibility assessments by prioritizing dynamic travel times and adopting recommended knowledge production and use practices.

The following section details some key features and good practices that contribute to addressing present challenges:

- **Multistakeholder engagement**: a diverse intersectoral team of stakeholders contributes to the AMORE Project throughout the research process, and their inputs also informed the AMORE Platform conceptualization and development. Contributors to the AMORE Project Collaborative Group represent the government, community, health service providers, and end users (consumers) who may directly or indirectly shape decisions, policies, plans, and programs.

- **Measurement** of dynamic travel times using “time to destination” is a universal and comparable metric used by urban dwellers and users of navigation and travel apps.

- **Digitization and datafication** by using anonymized publicly available georeferenced data of housing, people, and services, including disaggregated sociodemographic characteristics.
• **Using analytics and modeling** to obtain reasonable estimates and maintain efficiencies and affordability while still delivering valid and reliable forecasts.

• **Disaggregating sociodemographic data** to deliver an equity analysis of accessibility.\(^{60-62}\)

• **Scalability and replicability** using sources increasingly available to low- medium, and high-income settings. The approach can be scaled, adapted, and replicated to other locations, transportation means, services, or sectors.

Subsequent research will explore if revealing territorial inequities in urban and health services planning could catalyze intersectoral responses.\(^{40,63-67}\)

Intersectoral collaborations rarely occur naturally and are challenged by the lack of consensus on issues and metrics. Using metrics and methods that all parties understand and facilitate direct communication could contribute to intersectoral action; assessing this will require additional research and is the subject of a separate proposal.\(^{1,15,64,68-71}\)

**Objectives**

**General objective**

To assess dynamic accessibility assessments for selected healthcare services in urban Cali, Colombia, and predict the maximum improvements possible if new services were added.

**Specific objectives**

• To assess the temporospatial characteristics of equity and accessibility to hemodialysis, radiation therapy (radiotherapy), and tertiary care emergency services when traveling by car in urban Cali, Colombia.

• To provide dynamic assessments based on selected (arbitrary) travel time thresholds.

• To assess if populations in a situation of vulnerability needing hemodialysis, radiotherapy, and tertiary care emergency services will likely incur longer journeys when traveling by car in urban Cali, Colombia.

• To identify common variations of dynamic accessibility at two moments of the COVID-19 pandemic from an equity perspective.

• Assess the magnitude of absolute and relative accessibility variations attributed to traffic congestion.

• To estimate potential improvement for accessibility gained by expanding services.

**Materials and Methods:**

This cross-sectional study uses a research design of GIS modeling applied to case studies based on analyses of publicly available secondary data. This study will conduct paired cross-sectional assessments comparing equity in health services accessibility for July 6 – 12, 2020, and the week of 23 – 29 November 2020.

Reporting of study results will follow the STROBE Guideline for cross-sectional observational studies and incorporate elements from other guidelines, such as those on equity assessments (CONSORT-E
and PRISMA-E equity extensions), public health and policy interventions (TiDeR-PHP), reporting of analytical models (e.g., SPIRIT-Al extension), and multistakeholder engagement with patient and public participation in research (GRIPP2).  

**Context and Study Population**

The study is a proof-of-concept for implementation in Cali (est. 2,258 million in 2020), the third largest and most populous city in Colombia and the dominant urban center of Colombia’s southwest and pacific regions (approx. 564 km$^2$). The study includes the entire urban population. Nearly half of Cali’s population lives in low-income housing, 41% in medium income, and 9% in high-income housing. About 84% of the population identifies as white descent, and 14% identify as Afro-descendent, with a small proportion identifying as Indigenous or Rom.  

The COVID-19 pandemic severely impacted the local economy. By January 2021, unemployment rates in Cali rose to 23.2% for women and 14.6% for men, a one-year increase of 8.1% and 3.1%, respectively. The situation was worse for the youth, with an estimated 52% of women and 47.2% of men dependent on the informal economy. One in 5 people was unemployed, and unemployment rates were substantially higher for those living in lower socioeconomic areas. Cali absorbed 139,000 migrants from Venezuela over the past five years, with more than 25,000 in 2020.

For the reports, contextual data will be obtained to provide an overview of the use and demand of services. Sources include reports and platforms such as “Cuentas de Alto Costo.”

In preparatory dialogues with contributors, we learned about plans to transform Cali into a Special District with its 22 communes converted into six to eight minor districts to be led by minor district mayors. This new political and administrative layout might raise interest in this topic as new authorities might want to discuss accessibility and equity issues with their constituents and in power-brokering negotiations, noting the equity implications of the concentration of health services in a few sectors of the city.

**Data Sources**

The study will use anonymized, aggregated data from the following data sources:

- Microdata of Colombia’s National Census for Cali 2018 was downloaded from the official public website of the National Department of Statistics—DANE. This provides sociodemographic data of the populations at the block level for the entire city. The census population had a 28.1% adjustment estimated for 2020 to account for intercensal growth, under-registration, and migration.

- The city’s transportation analysis areas (TAZ) and census administrative sectorization for urban Cali were obtained from the IDESC portal. This data allows linking TAZs with city blocks. TAZs are adequate to estimate travel times and less detailed than blocks, thus reducing the number of travel time measurements and adding anonymity to the population.

- Approved health services relevant to the chosen scenarios, obtained from the National Special Registry of health services providers – REPS from the Ministry of Health and Social Protection. The services geolocation was verified with Google Maps. Approved services were checked in June and October 2020 and January 2021, finding they remained unchanged. This
protocol will assess accessibility to the entire city’s fourteen tertiary care hospitals with emergency services (REPS Code “Alta complejidad” + 501); eleven hemodialysis units totaling 370 chairs (REPS code 733); five radiotherapy services (REPS code 711).

- **Google’s Distance Matrix API** provides big data measurements of travel times from the origin (TAZ for the residence) to the destination (TAZ of the health service). It allows the identification of travel time changes during the assessed weeks.

Data Integration: The AMORE Platform

Secondary data will be integrated into the AMORE Platform, a web-based digital platform developed with inputs and feedback from stakeholders and piloted by the AMORE Project. The Platform is hosted by IQuartil SAS. See [https://www.iquartil.net/proyectoAMORE](https://www.iquartil.net/proyectoAMORE).

The AMORE Platform was developed and tested following a design-thinking approach between June and August 2020. The digital web-based platform was developed for this project by the principal investigator with input from experts in data science, public health, logistics, and mobility and a wide range of stakeholders (A description of the development and piloting phases of the AMORE Platform can be provided).

Figure 1, Figure 2, and Figure 3 display examples of the AMORE Platform’s interface or “front-end” panels (presentation layers) with its zoomable choropleth maps and graphics that integrate multiple layers of data. Filters activated by tapping on the graphs act on sociodemographic variables, travel times, and health services to offer a descriptive analysis. The front-end has been developed with Microsoft’s Power BI™. The **back end** (data access layer) is written in Python™ open-source software from the Python Software Foundation – PSF and in the Konstanz Information Miner – KNIME, a free and open-source data analytics, reporting, and integration platform.

Study Variables

Reports will describe the people and percentages for the entire population able to reach services within a set threshold with peak and free-flow traffic conditions for each scenario. The variations in these accessibility figures will be disaggregated by sociodemographic characteristics such as gender, ethnicity, the socioeconomic stratum of housing, maximum education attainment, and marital status. These reports will contrast the statistics for peak and free-flow traffic conditions. These reports will use an arbitrary 15-minute threshold for accessibility by car to tertiary care emergencies and 20-minutes for hemodialysis and radiotherapy.

Graphs will be used to present variations in accessibility as traffic congestion increases for different travel time intervals (e.g., 10-minute intervals vs. accessibility for each socioeconomic stratum), as shown in Figure 4.

The contrast will be drawn between results obtained for July and November 2020.

Reports will include the location(s) maximizing accessibility if one or two new services are added, contrasting predicted accessibility vs. measured accessibility for July and November 2020, and the recommended services locations. For an example, see Figure 3.
All estimates in this test case use travel by car. Reports will include visualizations from the AMORE Platform, tables, and simple graphs with descriptive statistics.

Figure 1 Cali, accessibility to tertiary care emergency service late morning to early afternoon Mon-Sat. North to the right and west at the top

Figure 2 AMORE Platform Interface for situational analysis for tertiary care emergencies
Figure 3 AMORE Platform with predictive analyses of adding two new tertiary care emergency services.

Figure 4 Comparing accessibility by socioeconomic stratum, tertiary care emergencies.

Impact of traffic congestion on accessibility to tertiary care emergencies, by economic stratum of the dwelling.
Data Analysis

Data and images for analyses will be obtained from the AMORE Platform and presented using descriptive statistics for absolute figures (people) and relative (percentage of population), as shown in Figure 2 and Figure 3.

The use of relatable and commonly used metrics (i.e., time to destination), descriptive statistics (percentage of a population that can reach the services within a travel time threshold), visualizations, and simple graphs (e.g., Figure 2, Figure 3, Figure 4) and maps (e.g., Figure 1) are chosen to allow non-specialized stakeholders to understand the effects of accessibility on populations and health equity.

The study will deliver (1) situational analyses of accessibility to a selection of urgent or frequent health care services scenarios in urban Cali, Colombia, and (2) predictions of potential improvements to the accessibility of adding services under changing assumptions.

Arbitrary travel-time points will be used (15 minutes for urgent care; 20 minutes for frequent care services); we found no standards for travel time thresholds.

The situational analyses of accessibility will consider the following study scenarios:

1. **Urgent care**, assessing travel times to the health emergency department with the shortest journey by car, among the 14 hospitals with tertiary care emergency departments.
2. **Frequent care**, assessing travel times to ambulatory services that require regular use. The analyses will investigate the shortest journey to five radiation therapy services and eleven hemodialysis units.

   For these case studies, the project will deliver a:

   - **Situational analysis** uses descriptive and diagnostic analytics to assess accessibility under traffic conditions. Choropleth maps mark the boundaries of travel times Figure 1. The blocks building the map represent Traffic Analysis Zones (TAZ), and their height in the 3D choropleth map represents population density. By pointing to a TAZ, identification, population, and travel time to the nearest facility are displayed, and the sociodemographic characteristics of the people are presented in a dashboard (Figure 2). The dashboard also includes a choropleth map with the density of the population being analyzed.

   - **Optimization analysis** using predictive and prescriptive analytics for modeling. Using heuristic techniques, the research will predict accessibility with different service schedules or when adding up to two new services in locations that maximize accessibility. Case studies will focus on hemodialysis and radiotherapy, which are used to treat high-cost conditions and must be accessed repeatedly for prolonged periods. For example, hemodialysis usually requires 3-5 weekly sessions, and radiotherapy may require daily sessions for weeks. Predicted accessibility with new services will be compared with measured accessibility (Figure 3).

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Preparation for the Project

Beginning on June 12, 2020, interviews were conducted with key informants, local authorities, and experts to inform the project, assess feasibility, and develop a protocol. These interviews offered contextual insights and ideas for the AMORE Platform to address the needs of data users and stakeholders. Discussions helped identify contributors and provided valuable contextual information. They also revealed how stakeholders approached health equity and accessibility and the relationship to urban and health services planning and land use. Stakeholders offered insights into the elements and processes of urban and health services planning, public policy, and advocacy.

Interviewed key informants included:

- Members of the SIGELO Project on vulnerability, accessibility, and logistics in the context of the COVID-19 pandemic, Universidad del Valle
- Health equity and public health experts at the Bruyère Institute, University of Ottawa
- Contributors to Cali’s Administrative Department of Municipal Planning (DAPM)
- Advisors and staff working with Cali’s local government, including the secretariats of Health, Mobility, Urban planning, and Emergency response and preparedness.
- Data Science for All Team33 and IQuartil SAS analysts.
- Former local government and education authorities
- Urban observatories, urbanists, and networks on urbanism, mobility, and public health.
- Innovators and advisors working with health services and systems
- Service providers, including managers and science advisors
- Health services and accessibility data users
- Doctoral and professional networks
- Designers, graphic and science communications professionals, and artists
- Researchers and research sponsors.

Twenty-eight meetings were held with key informants and stakeholders between July 2020 and March 2022, when the advanced prototype of the AMORE Platform was completed. Two presentations were made to the Follow-up Commission of the Doctoral Program on Research Methodology for Biomedical Research and Public Health of the Universitat Autònoma de Barcelona.

During the preparatory phase, the project was also debated in international fora such as the Global Health Learning Network of the University of Ottawa, The 4th Urban Forum “Lima Cómo Vamos,” the CEDEUS-REDEUSLAC II International Symposium of Doctoral Candidates on Urban Development and Sustainability for Latin America, and the Caribbean (Chile), and with urban observatories (Cali, Bucaramanga).

These interviews shaped the AMORE project and platform. The objectives and platform were discussed from a theoretical perspective. Once the prototypes of the AMORE Platform became available, tests and demonstrations were made as part of the validation.

Data downloads and sources were stored in a dedicated repository using CSV formats to adhere to data sharing and reuse good practices. They will be made public with the publication of relevant research reports. Similarly, the AMORE Platform hosted by IQuartil SAS is made accessible with the completion of non-disclosure agreements. We expect to make platform sections publicly available.
Information of the project is stored in a protected area on the Open Science Framework website (https://osf.io/ypg5a/)

Fidelity/adaptation
The fidelity of the AMORE Platform is based on data validation and verification exercises, comparing the findings from the AMORE Platform using the two data downloads and the two development teams.

The results of the platform will likely be optimistic for several reasons. For example, people do not always travel to the service with the shortest journey for known (e.g., lack of coverage from the insurance in the institution) and unexpected reasons (familiarity, poor navigation aids, reputation). The potential for improved accessibility would be accurate if all people were entitled to access those services.

The census includes respondent-reported data that is subject to interpretation. For example, variables like disability and health status are self-reported, and the question is unspecific. Respondents may not find a suitable response option. For example, ethnicity has no category for Caucasian or mestizo populations representing a substantial part of the population. People with mixed backgrounds may find no suitable option to represent them.

The census is still well suited for this study: the data has been digitized, and sociodemographic data are linked with the residential block. The place of residence is a common starting point for people undergoing hemodialysis or radiotherapy, children, the elderly, and those not engaged in formal employment.

Mobile phone data is impractical because it cannot be accurately tied to reliable sociodemographic data; coverage varies among the population and excludes those unregistered as users or without a phone. It also has technical limitations.

Accessibility and spatial equity have been studied in Cali by the Research Group on Transport, Transit and Roads (GITTV) of the Faculty of Engineering of the Universidad del Valle. Members of this group contributed to the validation of the AMORE Platform, and the preliminary findings of the AMORE Platform are consistent with those of the GITTV and other authors.

Harms, risks, and ethical considerations
This observational study addresses the impact of mobility on health equity without researching human subjects and by integrating anonymized coded secondary data obtained from openly available records.

The study does not involve human subjects’ research. The AMORE Platform and dynamic geospatial analyses expose social justice issues and potential solutions of benefit to society by enabling informed decisions relevant to policies, plans, and procedures for improving health equity. This data can also predict or monitor changes in urban accessibility. The data used is anonymized and publicly available. Under Colombian law, this component fits the definition of research without risk, as described in Resolution 008430-1993 of the Ministry of Health. This was corroborated on July
25, 2022, by the Research Ethics Committee of the School of Engineering of the Universidad del Valle, which declared the project “without risk” per Colombian law (Ref: CEIFI 010-2022). The project was cleared on September 16, 2022 by the Commission on Ethics in Animal and Human Experimentation (CEEAH), and the Vice-Rector for Research, Universitat Autònoma de Barcelona (Ref: CEEAH-6100) on September 20, 2022.

The study can challenge current thinking with data and disrupt traditional approaches to land use and health services planning that may perpetuate pervasive inequalities that could fuel social strife and corruption.101–104,108–114

The ethical approach of this study follows the broader principles and considerations of public health ethics and health systems ethics; it generates population data valuable to address inequity and social injustice, is helpful for accountability and is relevant to intersectoral action.115,116 The need for further guidance on these issues remains a challenge for cross-sectoral collaboration. It is part of the ongoing discussions on stakeholder engagement in global health.73,117

Accessibility is a determinant of health on the supply side of health equity.118 Useful, valid equity assessments in accessibility matter to health systems and social justice. Having action-oriented data to challenge established thinking might contribute to various SDGs, such as improving good health and well-being (SDG 3), reducing inequalities (SDG10), having sustainable cities and communities (SDG11), improving infrastructure (SDG 9), and facilitating partnerships to achieve the SDGs (SDG17).12,13,18,64,115

These ideals are synergic with other urban development and planning initiatives on a human scale: Smart City, the 15-minute City, the Caring City, and the Committed City. Having data is the first step for technology to serve the needs of urban dwellers and inform public policy regularly or when facing health emergencies and pervasive inequities.12,119–121

The risks of this study are especially those associated with data science and artificial intelligence. Travel time data providers do not disclose the algorithms they use. These are empirically known to be accurate and are expected to be more accurate for the areas most traveled by people with network-engaged smartphones and sites where infrastructure and conditions remain stable; accuracy may vary across the city.5,122

There is a risk of errors in programming or labeling data; to control this risk, the validity of the data was tested, repeatedly reviewed, and found sensible by experts and local contributors. The chance that inaccuracies result from clustering traffic and times is low and is unlikely to change the overall picture the project analyzes.

The project reveals accessibility levels for populations and sectors of the city. It uses heuristic analysis to identify areas in which new services would significantly impact accessibility. These areas, like traffic conditions, may evolve. However, the data provided to inform decisions gives an overall idea of the locations that would optimize accessibility. It is unlikely that conditions and populations would change fast enough to make those broad estimations suddenly irrelevant. Regular updating of the AMORE
Platform would allow assessing these variations and would be the subject of further studies after this test case.

Additional factors influence the use of a service, including insurance coverage entitlements. Exploring this would require different data layers and funding that exceeds the purpose and scope of the test case and would be a matter of subsequent implementation.

There is an inherent risk of revealing social injustices or inequities that can lead to discomfort, alienation, or corrective action.

**Dissemination, promotion, and implementation of findings**

As part of the project, communication tools such as animations, infographics, videos, summaries, and logos were developed.

The research team seeks to publish its reports in open-access impactful journals and present them to diverse audiences, including observatories, networks, and intersectoral groups.

The planned reports include:

- Accessibility of health services for the urban population of Cali, 2020: urgent care and frequent care
- Predicted accessibility of health services for the urban population of Cali with the addition of health services in areas that would maximize accessibility (urgent care and frequent care scenarios) or changes in service schedules (frequent care)
- Editorials and methodological articles.

**General Declarations**

This project has no human subjects’ research; it uses anonymized, openly available data sources seeking quality improvements in health services. This version of the protocol was completed and prepared for publication following the approval by ethics review committees, and includes a graph published in Figure 4 from the first published reports.96

The Follow-up Commission of the Doctoral Program on Biomedical Research Methodology and Public Health of the Universitat Autònoma de Barcelona reviewed the study in September 2020 and 2021.

**Acknowledgments**

The following people contributed to the brainstorming preceding the writing of the protocol and approved this acknowledgment: Peter Tugwell and Vivian Welch (Campbell Collaboration and Cochrane Equity Group); Myriam Rosero and Maria Fernanda Tobar Blandón (Universidad del Valle); Alberto Concha-Eastman (Senior Advisor to the Secretary of Public Health of Cali); David Paredes Zapata (Hospital Clinic, Transplant and Organ Donation Section, Barcelona, Spain); Fredy Enrique Ágredo Lemus (Ph.D. student in Health, Universidad del Valle and advisor to the Secretary
of Health of Cali); Cristian García (Grupo de Aseguramiento y Desarrollo de Servicios e la Secretaría de Salud de Cali); Fernando R. Martínez A. (Departamento Administrativo de Planeación Municipal); and María Fernanda Merino. As a tutor for the Doctoral program at the Universitat Autònoma de Barcelona, Dr Xavier Bonfill I Cosp has provided guidance with the academic program and reports. We are grateful to contributors working for the Escuela de Escuela de Salud Pública and the Departamento de Administración y Organizaciones of the Universidad del Valle, the Secretaría de Movilidad, and the Centro Regulador de Urgencias y Emergencias del Valle.

We thank artist Adriana Cabal Aulestia for authorizing the use of Cali-themed paintings to illustrate the presentations and graphic designers Ingrid Faber and Carlos A. Faber for preparing the infographics. Ingrid Faber was commissioned to develop the logo and animation.

We acknowledge the contributions of the Team33/DS4A members to developing the prototype of the AMORE Platform: Catherine E. Cabrera, Daniel Cuervo, Darío Mogollón, Juan P. Morales, Santiago A. Tovar, Stephanie A. Rojas, Juan G. Betancourt, Rafael E. Ropero.

Stephen Volante and Cristina Cuervo provided editing assistance for early versions of the protocol.

Conflicts of interest / confluent interests
LGC is contributing his time in his personal capacity and as part of his part-time doctoral studies. His contributions and reports do not necessarily reflect the policies or decisions of his employer, the Pan American Health Organization (PAHO/WHO).

IQuartil SAS was commissioned to develop the backend and front end of the AMORE Platform and to host the platform. DCA was part of Team 33, where he led the team in developing the prototype of the AMORE Platform in coordination with the principal investigator. DCA is also a partner in IQuartil SAS and guided the company’s technical support and coordination with the principal investigator. LFP worked with IQuartil SAS until March 2021.

Funding sources
IQuartil SAS received consulting fees to support the development of the advanced prototype of the AMORE Platform. The prototype of the AMORE Platform was developed as part of a collaboration between the principal investigator and Team33 during the Data Science for All (DS4A) training. No grants have been secured to support this project that the principal investigator has financed. Subsequent developments of the AMORE platform have not been considered part of the objectives or reach of the AMORE project.

What is already known on this topic – dynamic travel times are not available for most cities, including Cali, and are not integrated into urban and health service planning; dynamic geospatial analyses reveal the effects of traffic congestion on health equity and accessibility to health services, a determinant of health.

What this study adds – it will provide estimates of accessibility with an equity perspective using simple methods and metrics that concerned stakeholders might find familiar. This will test if dynamic accessibility assessments can be done with existing data. The study adds an approach to analyzing dynamic geographic accessibility by tapping into hundreds of thousands or millions of observations to analyze, predict, improve geographic accessibility to health services, and identify new correlations.

How this study might affect research, practice, or policy – This study will provide a new metric and data source to address inequities aggravated by poor accessibility offering new perspectives on land use and the expansion of health services. The study prioritizes travel times over distance, accounting for the temporospatial variations caused by traffic congestion. Subsequent examinations can explore stakeholders' valuing of the data and their communication of the methods and findings with peers and counterparts.
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The Theory of Change is provided as an annex in page 31
Annex – Theory of Change

The 2022 goals of the AMORE Project and how they will be achieved

What is the problem you are trying to solve?
Long travel times to reach health services impact health equity and health outcomes. Poor understanding.

Lack of data limits understanding of the relationship between travel times and traffic, populations, and services needed to monitor accessibility and implement solutions.

Lack of tools that enable intersectoral collaboration and intersectoral action to bring these actors towards common goals.

Who is your key audience?
Shapers of health services planning
Authorities
- Urban planning
- Health services planning
- Mobility
- Smart cities
- Land use

Operational
- Patient advocates
- Watchdogs
- Insurance/payers
- Service providers
- Patient groups

Collective
- Academia
- Non-government organizations
- Political groups
- Policy groups
- Media

What is your entry point to reaching your audience?
Interviews, deliberations, focus groups, champions
Collaborative creation of solutions and knowledge
Health services providers and users
Advocacy groups and watchdogs

Urban planners
Integrated knowledge
Translation and knowledge brokers
Science, communication, media, events

What steps are needed to bring about change?
Revealing and monitoring accessibility with a health equity perspective by providing data on travel times and equity.
Use simple methods and descriptive data for all stakeholders can understand and use. Allow data to speak for itself.
Socialization and promotion of findings and data, allowing stakeholders and decision-makers to test assumptions and reach conclusions.

What is the measurable effect of your work?
There is available data on cities’ dynamic travel times at peak and free-flow traffic levels.

Measurable effect?
Dynamic data of accessibility inform policies and programs and monitoring.

Wider benefits?
- Indicators based on dynamic travel times are proposed to assess and improve accessibility.

What are the broader benefits of your work?
- proposed approach with web-based platforms used to monitor or assess accessibility

Equity and accessibility are integrated into urban health services planning.

Wider benefits?
- Stakeholders can communicate accessibility and equity findings to counterparts and peers

Measurable effect?
Available situational analyses and predictive and prescriptive analyses to improve accessibility

Stakeholders committed to social justice, health equity, and collaboration

- Drive for intersectoral collaboration
- Transparency
- Governance
- Accountability

- Commitment to social justice and equity
- Common understanding of data / tools

- Good will
- Collaboration & participation
- Resources invested in solutions

- Accessibility leads to better service use
- Other access barriers under control
- Application

- Stakeholders armed to push for enhanced accessibility
- Local uptake and ownership

Inspired by Nesta (2011) Theory of Change

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