

# Strategies to Reduce Geographic Inequity of Specialist Access in the Amazon

Evidence from TeleAmes Program

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- Can teleinterconsultation reduce geographic inequity of specialist access?
- Does TeleAmes reduce reliance on Out-of-Home Treatment (TFD)?
- Does telemedicine substitute or complement in-person specialist care?
- What are the effects on specialist access, patient transfers, travel distances, and TFD expenditures?

- Remote Brazilian municipalities face persistent specialist shortages.
- Specialist shortages cause delayed care and reliance on Out-of-Home Treatment.
- Approximately 70% of specialist physicians are concentrated in large urban centres of the Southeast and South.
- The North region has persistent shortages of specialist physicians and geographic barriers to service availability.
- Teleinterconsultation is a synchronous provider-to-provider telemedicine strategy.

- TeleAmes is a large-scale public telemedicine programme in Northern Brazil.
- It was implemented by SUS in partnership with Hospital Israelita Albert Einstein.
- It provides synchronous teleinterconsultations across multiple specialties.
- Primary care clinicians consult remote specialists in real time, with the patient present.
- The programme was implemented gradually across municipalities.

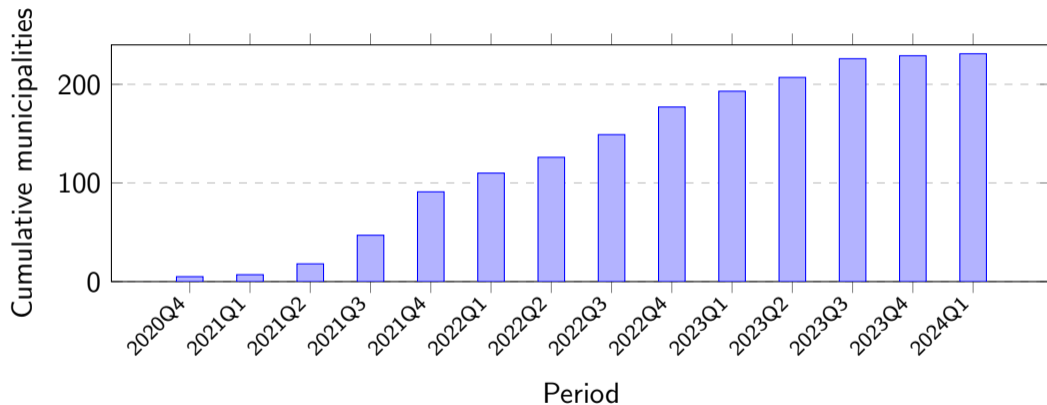


Figure reconstructed from Figure 1 in the paper.

- TeleAmes administrative data:
  - monthly teleinterconsultations;
  - doctors' specialty;
  - ICD-coded reasons for consultation;
  - date, health facility, and municipality of the patient.
- Ambulatory Information System from DATASUS (SIA):
  - outpatient service utilisation;
  - specialist consultations;
  - diagnostic procedures;
  - TFD authorisations;
  - transportation modes;
  - travel distances;
  - associated expenditures.
- Population data from the 2022 Census and IPCA inflation index.

## Primary outcomes

- 1 Specialist access:
  - specialist teleconsultations;
  - in-person specialist consultations recorded in SIA.
- 2 Teleinterconsultations reported by TeleAmes.
- 3 Out-of-Home Treatment procedures:
  - land;
  - river;
  - air travel.

## Secondary outcomes

- TFD expenditures by transport mode.
- Travel distances by transport modality.

## Callaway and Sant'Anna difference-in-differences estimator

$$ATT(g, t) = \frac{\sum_i (Y_{it} - Y_{i,g-1}) 1\{G_i = g\}}{\sum_i 1\{G_i = g\}} - \frac{\sum_i (Y_{it} - Y_{i,g-1}) 1\{C_i = 1\}}{\sum_i 1\{C_i = 1\}}$$

- $i$  indexes municipalities.
- $t$  indexes quarters.
- $G_i$  denotes the first period in which municipality  $i$  receives treatment.
- $C_i = 1$  indicates municipalities not yet exposed at time  $t$ .

$$ATT_i^w = \sum_g w_g ATT(g, g + l)$$

- Group-time average treatment effects are aggregated by length of exposure.
- Standard errors are clustered at the municipality level.
- Specifications include municipality fixed effects and quarter fixed effects.
- Results are estimated separately for:
  - 1 TeleAmes full sample;
  - 2 TeleAmes sample excluding state capital and its metropolitan municipalities.

# Table 1: Descriptive Statistics – North Sample Consultations and Teleconsultations Baseline

Variable	Mean	Std. Dev.	Min	Max	Obs
Teleinterconsultations (HIAE administrative data) per 1,000 Inhabitants	0.000	0.000	0.000	0.000	924
Total Number of Teleconsultations with Specialists per 1,000 Inhabitants	0.000	0.000	0.000	0.000	924
Number of Specialist Consultations per 1,000 Inhabitants	8.808	33.249	0.000	377.516	924
Ratio Between Teleconsultations and General Consultations	0.000	0.000	0.000	0.000	881

# Table 1: Descriptive Statistics – North Sample Transfers Outside the Domicile (TFD) Baseline

Variable	Mean	Std. Dev.	Min	Max	Obs
Number of TFD Procedures per 1,000 Inhabitants	7.744	12.515	0.000	100.350	924
Food Allowances per 1,000 inhabitants	2.400	4.410	0.000	46.574	924
Number of Land Transportations per 1,000 Inhabitants	3.436	8.825	0.000	95.623	924
Number of River Transportations per 1,000 Inhabitants	1.136	6.297	0.000	75.264	924
Number of Air Transportations per 1,000 Inhabitants	0.751	1.119	0.000	8.926	924

# Table 1: Descriptive Statistics – North Sample Distances Traveled Baseline

Variable	Mean	Std. Dev.	Min	Max	Obs
Average Distance of Land Transportations	7.381	12.764	0.000	68.000	924
Average Distance of River Transportations	1.867	6.376	0.000	59.000	924
Average Distance of Air Transportations	5.682	6.330	0.000	54.000	924

# Table 1: Descriptive Statistics – Reduced North Sample Consultations and Teleconsultations Baseline

Variable	Mean	Std. Dev.	Min	Max	Obs
Teleinterconsultations (HIAE administrative data) per 1,000 Inhabitants	0.000	0.000	0.000	0.000	832
Total Number of Teleconsultations with Specialists per 1,000 Inhabitants	0.000	0.000	0.000	0.000	832
Number of Specialist Consultations per 1,000 Inhabitants	8.434	33.962	0.000	377.516	832
Ratio Between Teleconsultations and General Consultations	0.000	0.000	0.000	0.000	791

# Table 1: Descriptive Statistics – Reduced North Sample Transfers Outside the Domicile (TFD) Baeline

Variable	Mean	Std. Dev.	Min	Max	Obs
Number of TFD Procedures per 1,000 Inhabitants	8.231	12.970	0.000	100.350	832
Food Allowances per 1,000 inhabitants	2.505	4.613	0.000	46.574	832
Number of Land Transportations per 1,000 Inhabitants	3.737	9.103	0.000	95.623	832
Number of River Transportations per 1,000 Inhabitants	1.259	6.625	0.000	75.264	832
Number of Air Transportations per 1,000 Inhabitants	0.710	1.112	0.000	8.926	832

# Table 1: Descriptive Statistics – Reduced North Sample Distances Traveled Baseline

Variable	Mean	Std. Dev.	Min	Max	Obs
Average Distance of Land Transportations	7.684	13.010	0.000	68.000	832
Average Distance of River Transportations	1.846	6.545	0.000	59.000	832
Average Distance of Air Transportations	5.392	6.162	0.000	48.000	832

# Table 1: Descriptive Statistics – Reduced North Sample TFD Expenditure Baseline

Variable	Mean	Std. Dev.	Min	Max	Obs
Expense per 1,000 Inhabitants	2054.750	2364.394	0.000	19530.930	832
Expense on Food Assistance per 1,000 Inhabitants	536.749	782.256	0.000	9747.732	832
Expense on Land Transportation per 1,000 Inhabitants	263.445	701.910	0.000	6775.132	832
Expense on River Transportation per 1,000 Inhabitants	96.248	536.893	0.000	5882.761	832
Expense on Air Transportation per 1,000 Inhabitants	1140.426	1825.099	0.000	15810.676	832

# Table 1: Descriptive Statistics – North Sample

## TFD Expenditure Baseline

Variable	Mean	Std. Dev.	Min	Max	Obs
Expense per 1,000 Inhabitants	2132.575	2419.564	0.000	19530.930	924
Expense on Food Assistance per 1,000 Inhabitants	545.633	771.923	0.000	9747.732	924
Expense on Land Transportation per 1,000 Inhabitants	241.121	671.309	0.000	6775.132	924
Expense on River Transportation per 1,000 Inhabitants	86.819	510.225	0.000	5882.761	924
Expense on Air Transportation per 1,000 Inhabitants	1236.109	1879.899	0.000	15810.676	924

The Baseline statistics reports the statistics of the dependent variable for the treated groups in 2019, a period prior to the first treatment adoption in the sample.

In a staggered Difference-in-Differences setting, defining a single baseline is not straightforward because treatment occurs at different times across cohorts.

The paper uses this fixed pre-treatment period to provide a transparent and stable benchmark for the scale of the outcome variable before the intervention begins.

Table 2: Impact on Specialist Consultations and Teleconsultations

	Sample	
	(1)	(2)
<i>Consultations per 1,000 Inhabitants</i>		
Teleinterconsultations (Internal Data) per 1,000 Inhabitants	3.912*** (0.327)	4.174*** (0.345)
Total Number of Teleconsultations with Specialists	0.202*** (0.063)	0.203*** (0.063)
Number of Specialist Consultations per 1,000 Inhabitants	7.670*** (2.907)	8.382*** (2.769)
<i>Share of Teleconsultations in Total Consultations</i>		
Ratio Between Teleconsultations and General Consultations	0.012* (0.007)	0.011 (0.008)

Sample (1) includes all municipalities in TeleAmes. Sample (2) excludes state capitals and metropolitan regions.

# Table 3: Impact on the Number of TFDs

	Sample	
	(1)	(2)
Number of TFD Procedures per 1,000 Inhabitants	-2.162*	-2.024
	(1.309)	(1.422)
<i>Procedures per 1,000 Inhabitants – By Type</i>		
Per Capita Number of Food Assistance	0.134	0.170
	(0.254)	(0.297)
Number of Land Transportations per 1,000 Inhabitants	-2.384*	-2.269
	(1.232)	(1.416)
Number of River Transportations per 1,000 Inhabitants	0.070	0.089
	(0.147)	(0.156)
Number of Air Transportations per 1,000 Inhabitants	0.063	0.041
	(0.044)	(0.042)

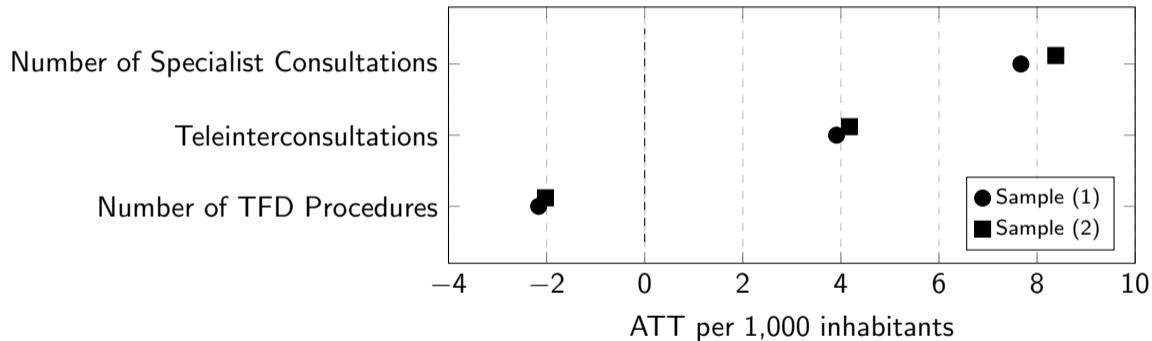
# Table 4: Impact on the Distance of Transportation by Type

	Sample	
	(1)	(2)
<i>Average Distance by Type of Transport</i>		
Average Distance of Land Transportations	1.088 (0.999)	1.186 (1.132)
Average Distance of River Transportations	0.266 (0.216)	0.201 (0.240)
Average Distance of Air Transportations	0.269 (0.376)	0.297 (0.406)

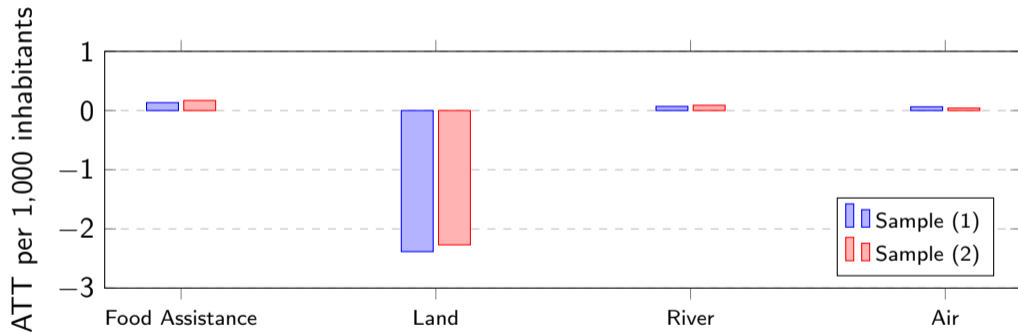
# Table 5: Impact on Transportation Expenses by Type

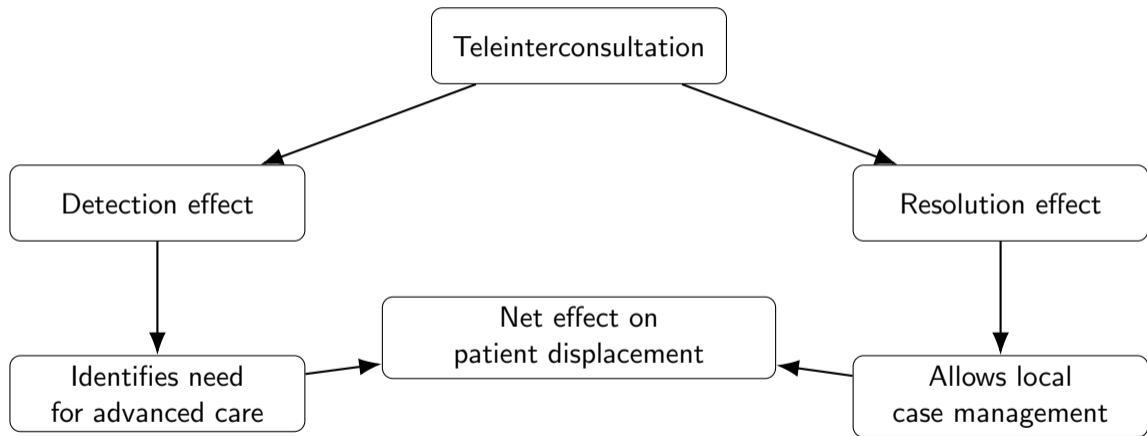
	Sample	
	(1)	(2)
Expense per 1,000 Inhabitants	1.787 (89.837)	-51.345 (98.117)
<i>Procedures per 1,000 Inhabitants – By Type</i>		
Expense on Food Assistance per 1,000 Inhabitants	12.175 (36.794)	4.288 (38.878)
Expense on Land Transportation per 1,000 Inhabitants	-17.695 (49.014)	-15.966 (56.249)
Expense on River Transportation per 1,000 Inhabitants	-19.572 (32.921)	-20.913 (37.134)
Expense on Air Transportation per 1,000 Inhabitants	42.628 (52.273)	3.430 (49.330)

# Coefficient Plot: Main Outcomes



# Impact on the Number of TFDs by Type





The paper states that the resolution effect outweighed the detection effect.

- Event-study analyses showed no significant pre-intervention trends.
- Most effects increased gradually over the first four to six quarters after programme adoption.
- The paper interprets this pattern as consistent with a learning curve as municipalities integrated teleinterconsultation into routine workflows.

- TeleAmes substantially expanded access to specialist care.
- Teleinterconsultations and SIA-recorded specialist teleconsultations increased.
- In-person specialist consultations also increased.
- Reductions in TFD procedures were concentrated in land transportation.
- Travel distances and expenditures showed modest, heterogeneous, or imprecise changes.

- Large administrative data.
- Large sample of remote municipalities.
- Causal identification strategy suited to staggered programme rollout.
- Evaluation under routine conditions.
- Multi-specialty telemedicine programme.

- Absence of patient-level clinical outcomes.
- Potential measurement error in administrative data.
- Statistical imprecision for less frequent outcomes due to a small sample size.

- Teleinterconsultation expanded effective specialist availability.
- TeleAmes reduced the need for patient travel, especially land-based transfers.
- Telemedicine may reduce geographic inequities in access to specialist care.
- Future work could assess patient outcomes, cost-effectiveness, and longer-term impacts on referral patterns and care coordination.

Thank you