Planning visits of home care teams with continuity of care and synchronization – a case study

Ana Raquel Aguiar[a]*, Maria Isabel Gomes[b], Tânia Ramos[a]

[a] *CEG–IST, Instituto Superior Técnico, Universidade de Lisboa, Portugal*

[b] *CMA–FCT, Centre for Mathematics and Applications, Nova School of Science and Technology*

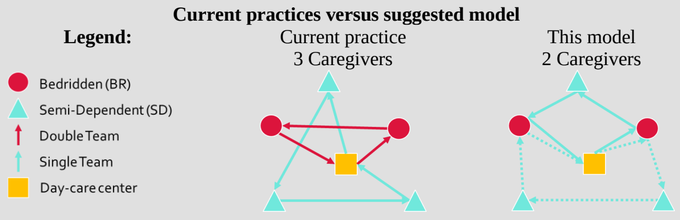
* Corresponding author: a.raquel.aguiar@tecnico.ulisboa.pt

Context

Sociodemographic trends along with healthcare delivery reforms have been **raising the demand for home care services**. Organizations providing these services **must increase the efficiency of their operational plans**, as they already present **long waiting lists** and must prioritize who to serve. This work aims **to develop a MIP model** to support the operational planning, so that a **better use of caregivers' working time will allow the provision of service to more patients**. It advances the literature by considering heterogeneous teams, composed of one or two caregivers. Moreover, when two caregivers are needed to perform one visit, the model may propose the allocation of one double team or the synchronization of two teams of one single caregiver.

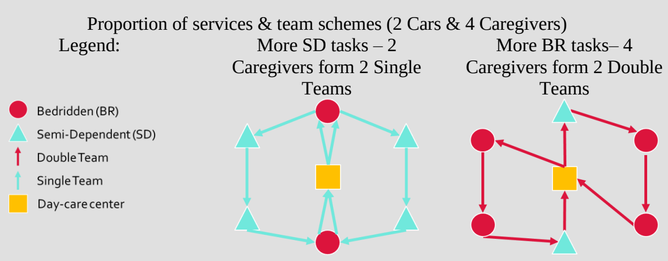
Home Care Model Features

Heterogeneous teams, of one or two caregivers, which serve patients requiring one (semi-dependent patients) or two caregivers (for bedridden patients). Efficiency gains in caregiver capacity by allowing **synchronization (syn)** of single teams while enforcing daily **continuity of care** is studied.



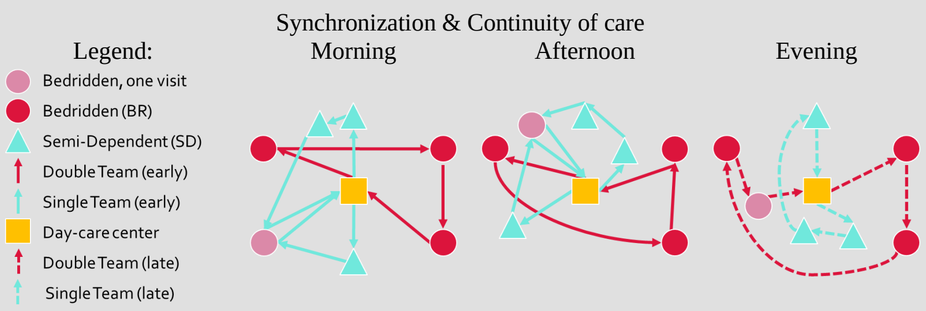
The model **designs routes**, **assigns tasks** to teams, decides **starting times**, the **number of teams of each type** and when to use **synchronization**.

Objective function - To **minimize working and traveling times**. Lunch break time serves as a **penalty for the number of caregivers**.



The number of teams of each type is bounded by the available caregivers and vehicles. Thus, **the proportion of service types** may lead to **different needs in team schemes** (left).

Continuity of care is defined as the preference to **allocate the same team through the planning horizon**. Since the horizon is longer than a shift, **at most two teams can be allocated** to a patient.



Daily continuity of care and synchronization are modeled simultaneously, assuring continuity of care by transferring bedridden patients to single teams.

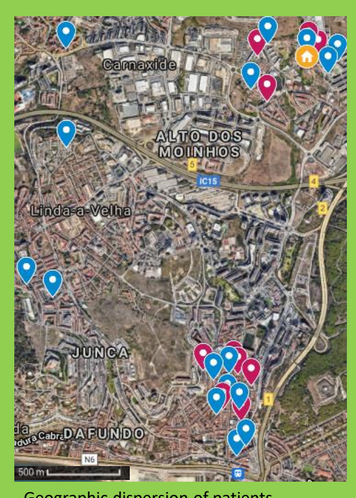
Case-Study

The partner, APOIO, provides home care services namely, support on the activities of daily living (medication assistance, home cleaning) and meal delivery.

- **Patient typologies:**
  - Bedridden (visits require 2 caregivers)
  - Semi-dependent (visits require 1 caregiver)
- **Home care:** 40 daily requests
- **Lunch distribution:** 100 meals
- **Homogeneous staff :** 9 caregivers
- **Homogeneous fleet :** 6 cars
- **Working period:** from 8 a.m. to 8 p.m.
- **Shift length:** 8 hours

Manual planning:

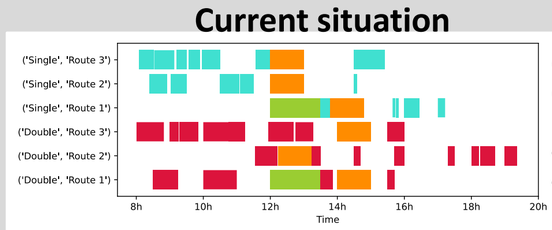
- Independent manual plan for each team type
- No synchronization of teams is allowed



Geographic dispersion of patients.
Blue – Semi-dependent, Pink – Bedridden, Orange – Day-care center

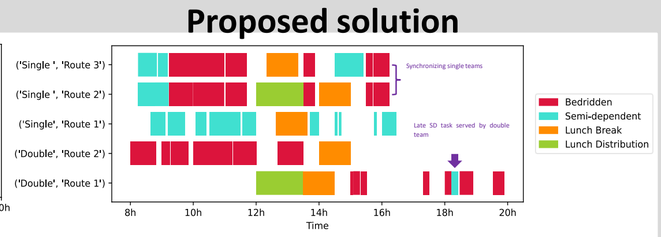
Results

Current situation



- Single teams serve semi-dependent patients and double teams serve bedridden patients exclusively.
- Uses all **9 caregivers**.
- Uses all **6 cars** (6 routes).
- **No synchronization** allowed.
- Some waiting/idle times.

Proposed solution



- Single teams can synchronize and serve bedridden patients; double teams can serve semi-dependent patients.
- Only **7 caregivers**.
- Uses **5 cars**.
- Synchronization allowed.
- Less waiting/idle times.

Allowing double teams to serve semi-dependent patients (integrated solve) reduces the number of caregivers in one.

Synchronization is the feature that most increases efficiency, allowing a reduction of two caregivers, but it exposes the routing plan to uncertainty.

When single teams synchronize, they perform sequences of the routes together, suggesting potential operational **cost reduction through car sharing.**

Conclusions

The developed model proposed solutions that increased the organization's capacity to answer home care requests, while complying with all organizational policies. In comparison to the current situation, **the proposed model reduced the number of caregivers required by two**, which are now free to serve more patients.

Acknowledgements

This work is funded by national funds through the FCT - Fundação para a Ciência e a Tecnologia, I.P., under the scope of projects UIDB/00297/2020 (Center for Mathematics and Applications), and UIDB/00097/2020 (CEGIST), along with a PhD grant SFRH/BD/148773/2019.