# Building a tool to support the planning of Long-Term Care networks under complexity: Dealing with multiple objectives, uncertainty and policy strategies

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# Agenda

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1. Long-term care
2. Research objectives
3. Previous research
4. Structuring the problem
5. Methodology
6. Case study
7. Conclusions
8. Future research

# 1. Long-term care

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## European context

- Ageing phenomenon
- Old-age dependency ratios

**Demographic trends**

- Changes in family structures
- Income & poverty risk

**Social determinants**

- Increasing prevalence of chronic diseases
- Functional status decay

**Health status**

Budget constraints

Increasing Demand for LTC

Inadequate public LTC Supply

- Inadequate utilization of acute care services
- Private vs Public provision

**Care provision**

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## European context

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- Inadequate utilization of acute care services
- Private vs Public provision

**Care provision**

Planning networks of LTC ranks high on the health policy agenda of many European countries…

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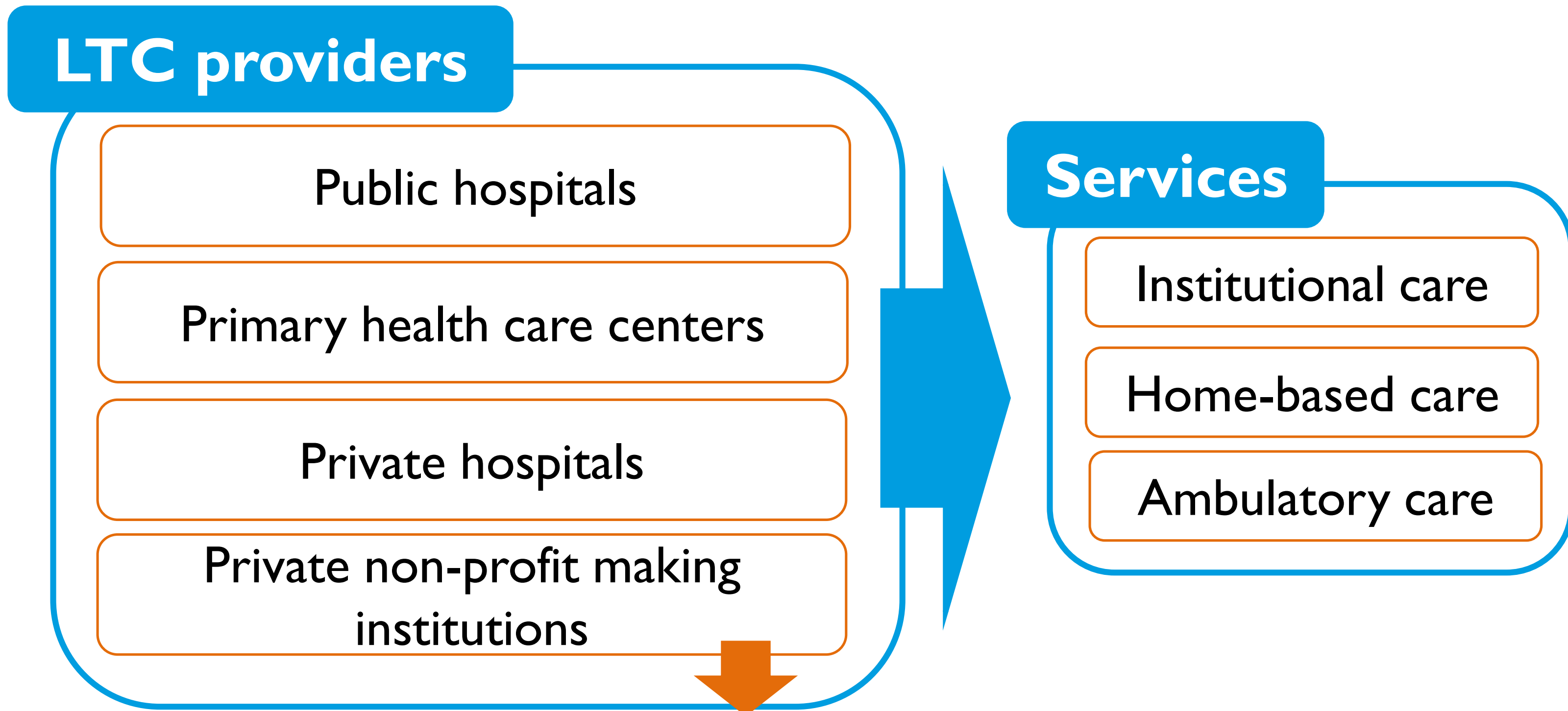
## … including in Portugal

NHS-based system & National Network of Long-Term Care (RNCCI) targeting coverage for all those in need from 2012 onwards




***Misericórdias* have been the largest provider in the RNCCI**

**52% of the total contracts within the RNCCI**

Barros et al., 2011
Ministry of Health and Ministry of Labor and Social Solidarity, 2006

# II. Research objectives

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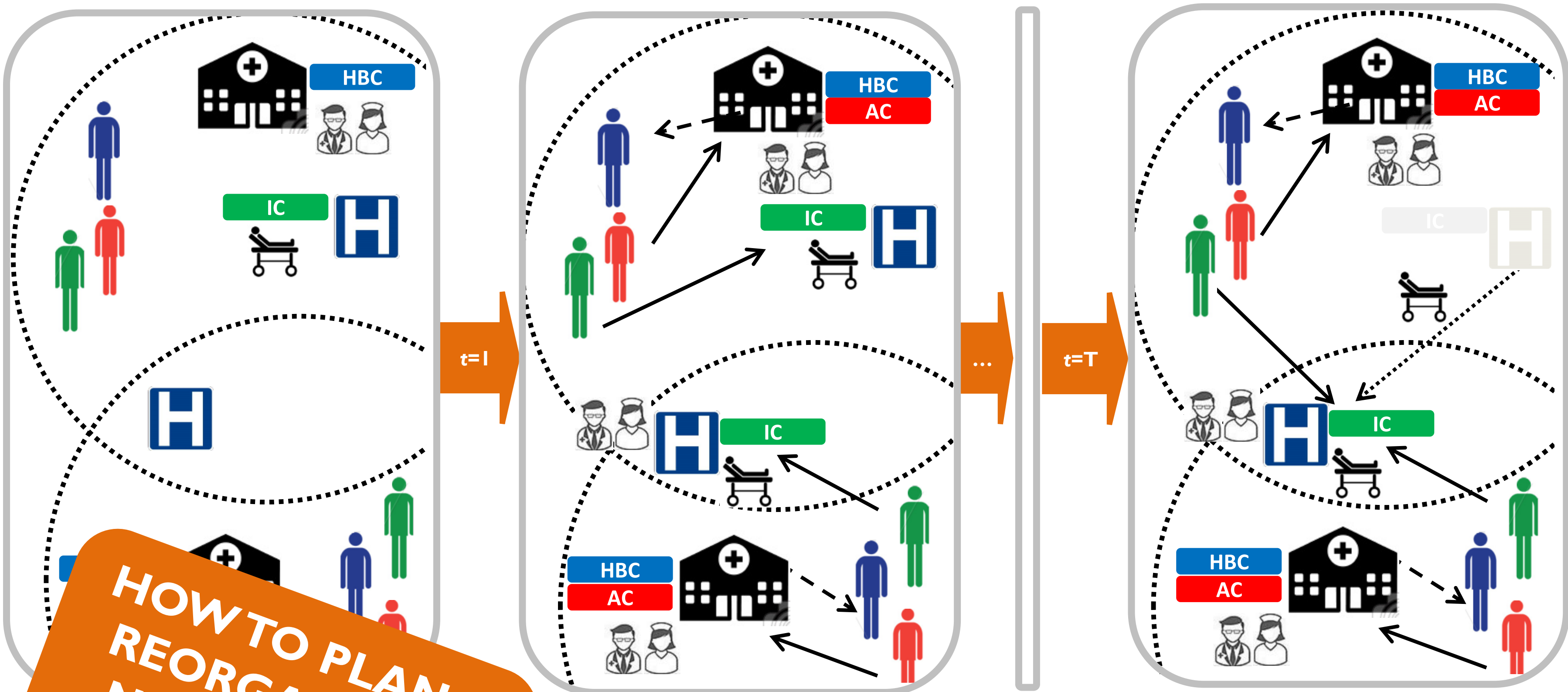
## Initial network of LTC




**Opening/closure of services?**

**Who receives care, and in which service?**

**How many beds and human resources are needed? And how to organize it?**

# II. Research objectives

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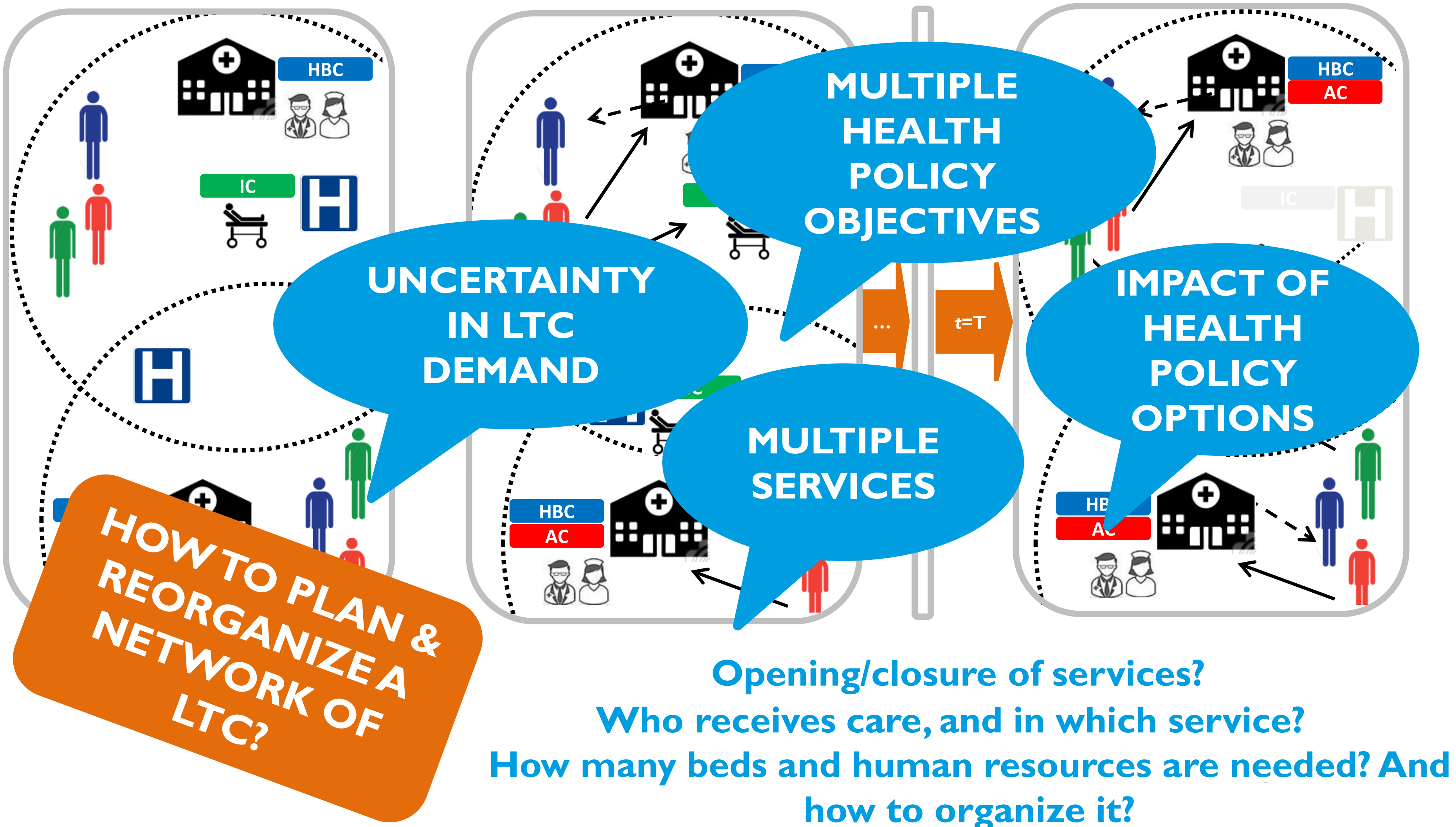


**Opening/closure of services?**
**Who receives care, and in which service?**
**How many beds and human resources are needed? And how to organize it?**

# III. Previous research

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**Optimization models have been widely used for supporting health care planning**

Aim at minimizing or maximizing an objective function, being this objective dependent on a finite number of decision variables and constraints

Four main components:
Decision variables, Constraints, Objective & Data

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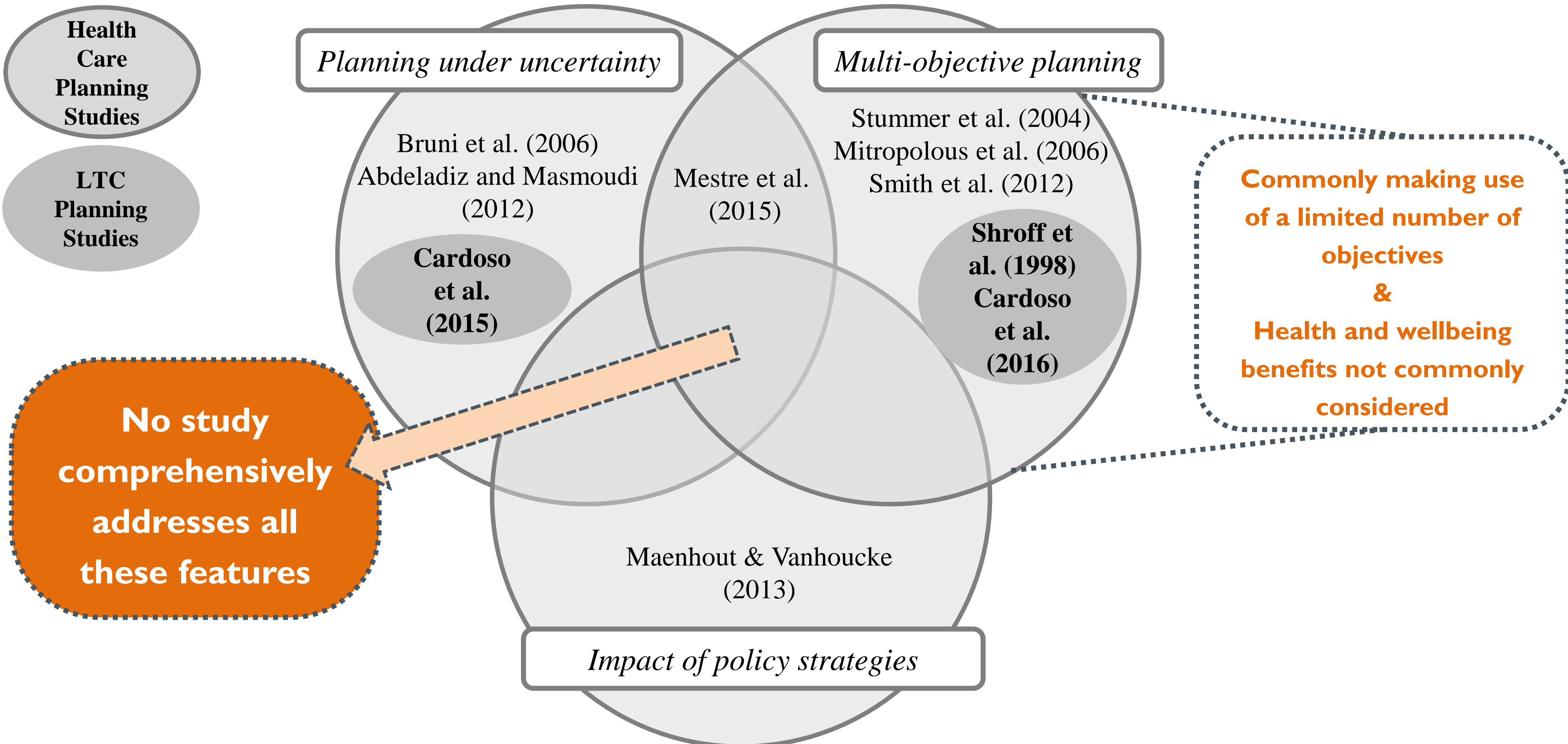
# Optimization models have been widely used for supporting health care planning



# III. Previous research

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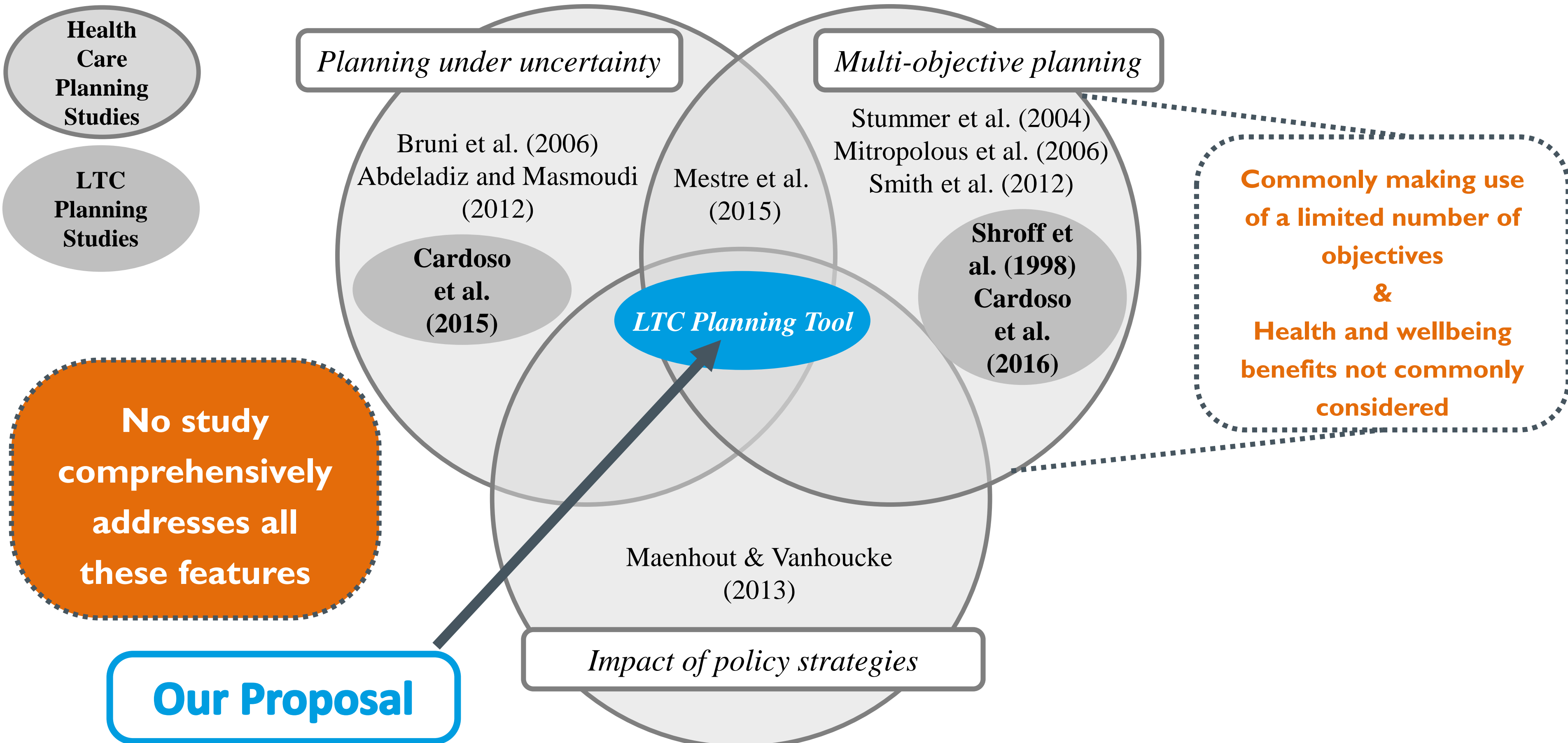
## Optimization models have been widely used for supporting health care planning



## And for that purpose…

**Planning tool based on optimization models to support the planning of LTC networks in the context of a NHS-based system that allows…**

- Planning the delivery of multiple services (institutional, home-based and ambulatory services)
- Pursuing multiple, and often conflicting, policy objectives
- Exploring the impact of uncertainty in the demand and the delivery of care
- Exploring the impact of policy strategies outside the LTC sector

## Structuring policy objectives

Policy Objectives

Equity

- Equity of Access
- Geographical Equity
- Socioeconomic Equity
- Equity of Utilization

Cost

Health & Wellbeing Benefits

- Health Gains
- Wellbeing Improvements

**Sources:** Baker (2000); Ministry of Health (2006); Kruk and Freedman (2008); Barros et al. (2011); Flynn et al. (2015)

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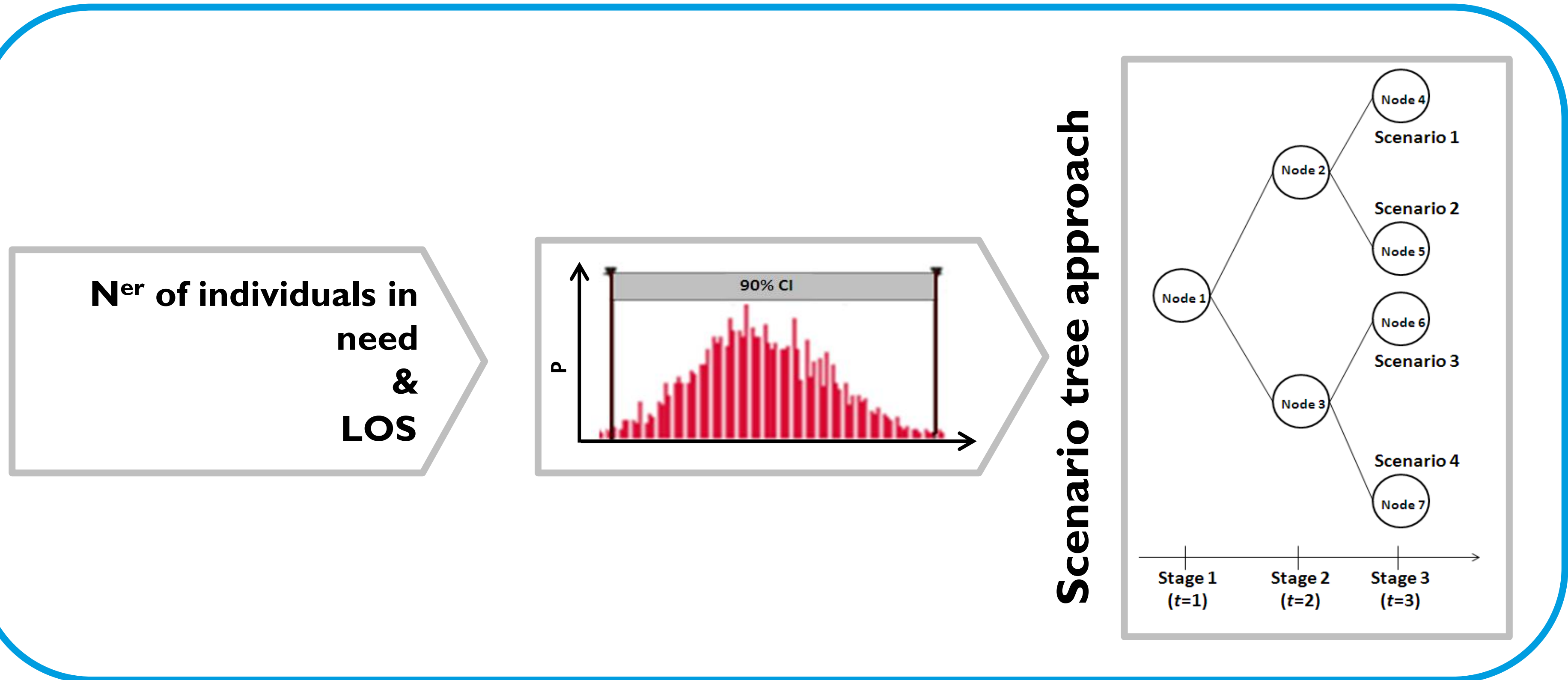
## Structuring uncertainty



## Structuring health policy decisions impacting LTC

**Policy decisions**

- Converting acute hospitals into LTC units
- Transferring resources to the LTC sector
- Changing the LTC provision paradigm

| Policy strategy | Hospital conversion | Transfer of resources (HR, MR or FR) from acute care to LTC | LTC provision paradigm |
|---|---|---|---|
| PS I | Yes | Yes | Community-based |
| PS II | No | No | Institutional-based |
| PS III | | | |
| PS IV | | | |
| PS V | | | |
| PS VI | | | |

**6 Policy Strategies (PS)**

**Strategy generation table (Kirkwood, 1997)**

HR: Human Resources; MR: Material Resources; FR: Financial Resources

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## Optimization model: Defining the objectives

**Objectives**

- Maximize Equity
  - Maximize Equity of Access
  - Maximize Geographical Equity
  - Maximize Socioeconomic Equity
  - Maximize Equity of Utilization
- Minimize Costs
- Maximize Health & Wellbeing Benefits
  - Maximize Health Gains
  - Maximize Wellbeing Improvements

Which combination of objectives should be considered?

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## Optimization model: Defining the constraints

| | |
|---|---|
| **Resources requirements** | Number of beds and human resources (HR) needed per type of LTC service. |
| **Reallocation constraints** | Beds and HR preferentially kept in their original service whenever a lack of resources exists in that service. |
| **Capacity thresholds** | Minimum and maximum numbers of beds and/or patients per service. |
| **Opening and closure of services** | Opening/closing a service is not allowed after deciding upon closing/opening it – only applied to IC services. |
| **Single and closest assignment** | Individuals in each demand point cannot be split, and must receive care in the closest available service. |
| **Equity satisficing levels** | Satisficing levels of equity of access, equity of utilization, socioeconomic equity and geographical equity are imposed. |


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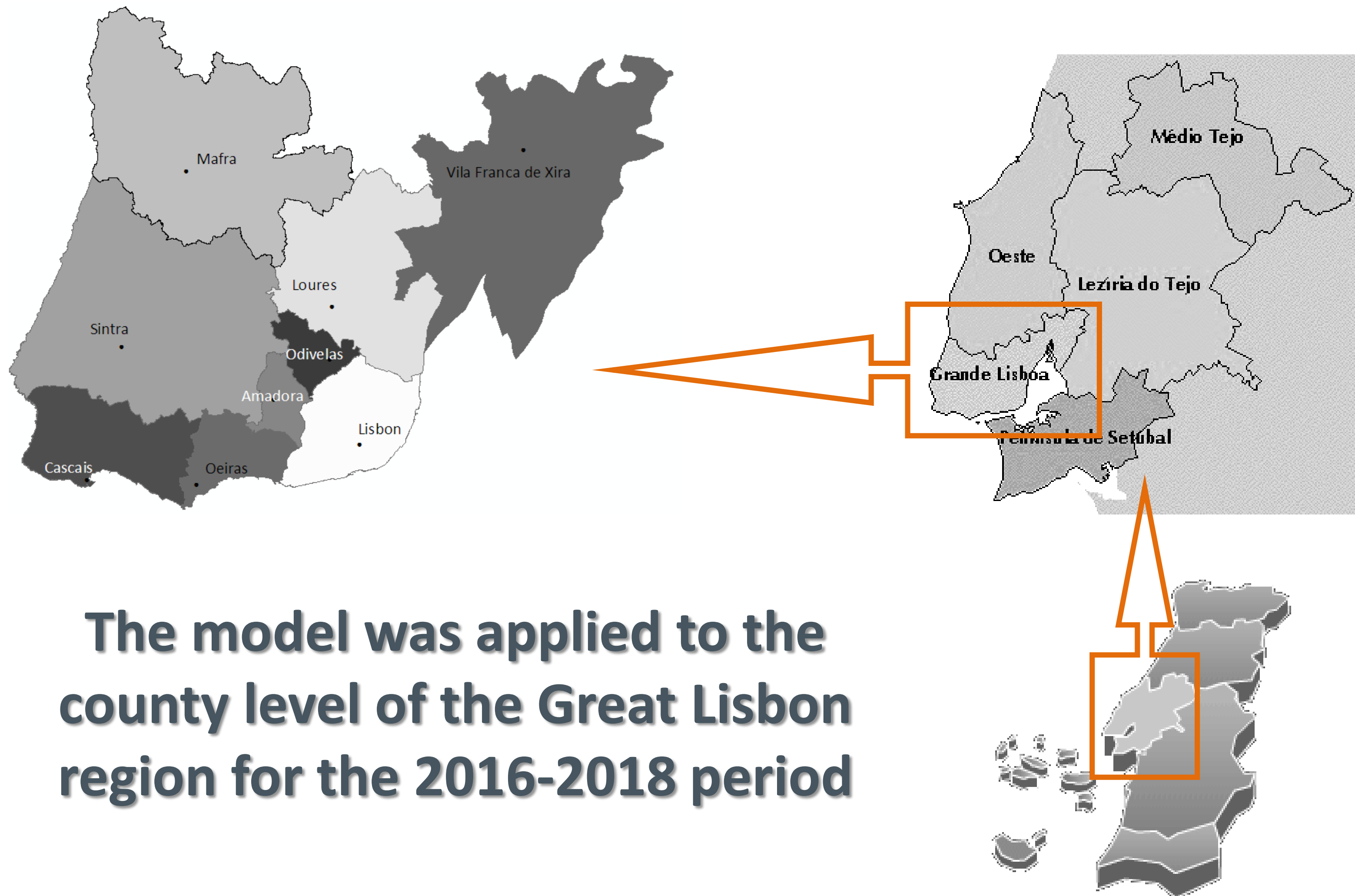
## Optimization model: Planning decisions

**Decisions**

- Where to open/close services?
- How much to invest in new beds?
- How should patients be allocated to LTC services?
- How much capacity should be in place (beds and human resources)?

# VI. Case Study




**The model was applied to the county level of the Great Lisbon region for the 2016-2018 period**

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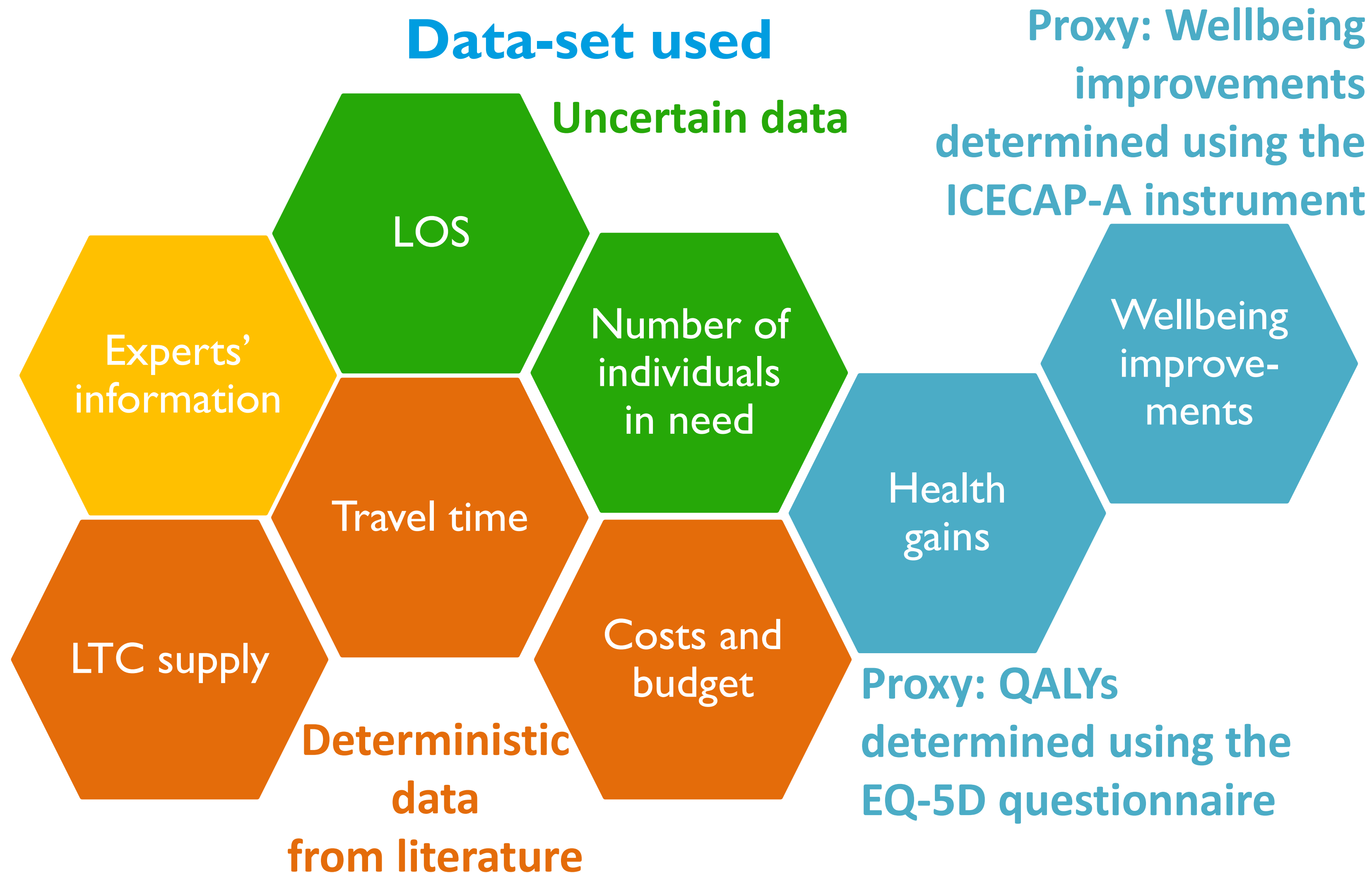
# Data-set used

# VI. Case Study: Data-set used



# VI. Case Study: Data-set used

## Data-set used

Different planning contexts may arise and should be analysed!

Experts' information

Policies?

Objectives?

| Policy strategy | Hospital conversion | Transfer of resources (HR, MR or FR) from acute care to LTC | LTC provision paradigm |
|---|---|---|---|
| PS I | Yes | Yes | Community-based |
| PS II | | | |
| PS III | | | |
| PS IV | No | No | Institutional-based |
| PS V | | | |
| PS VI | | | |

**Which policies should be adopted?**

**Which objectives should be pursued?**

| Policy Objectives | | | | | | |
|---|---|---|---|---|---|---|
| Equity | | | | Cost | Health & Wellbeing Benefits | |
| EA | GE | SE | EU | | HG | WI |

Uncertain data

LOS

from literature

Proxy: Wellbeing improvements determined using the

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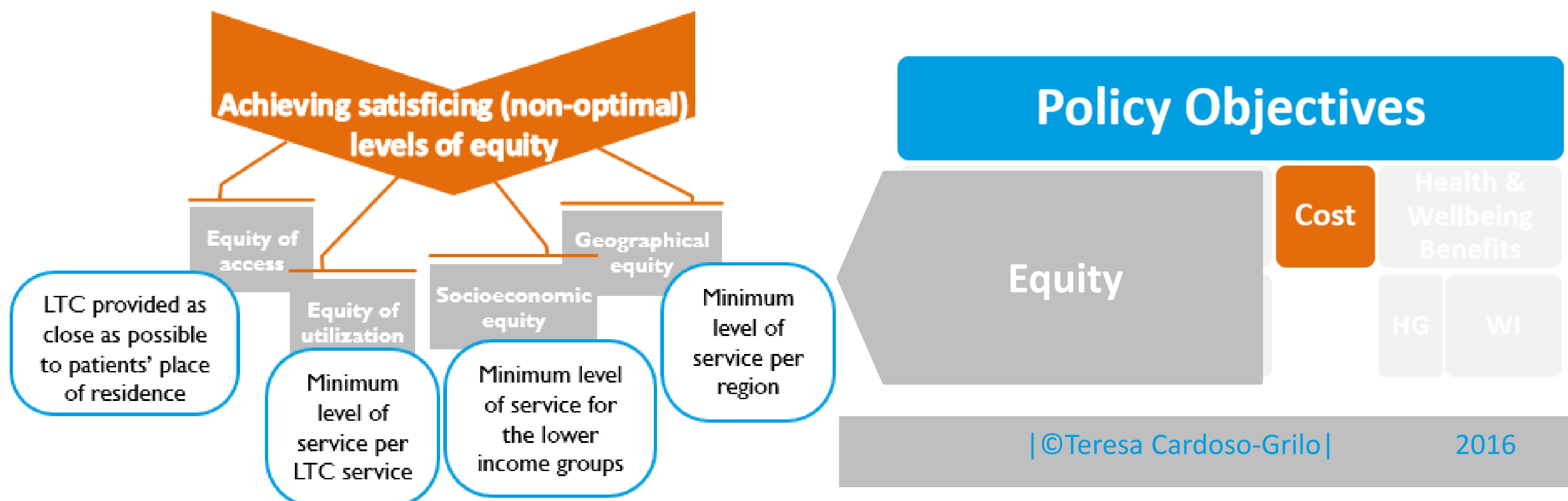
# Results

## I How should the LTC network be reorganized so as to minimize costs and when considering uncertainty in the demand and delivery of LTC?



# VI. Case Study: Results

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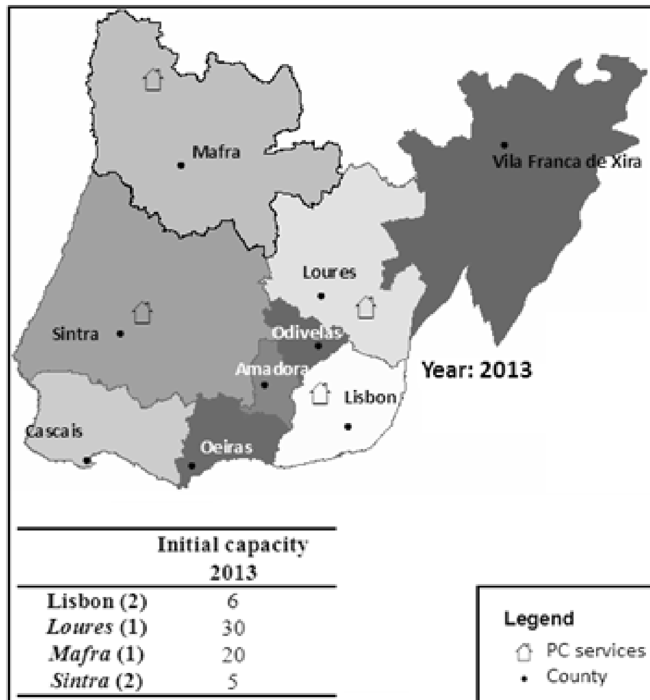
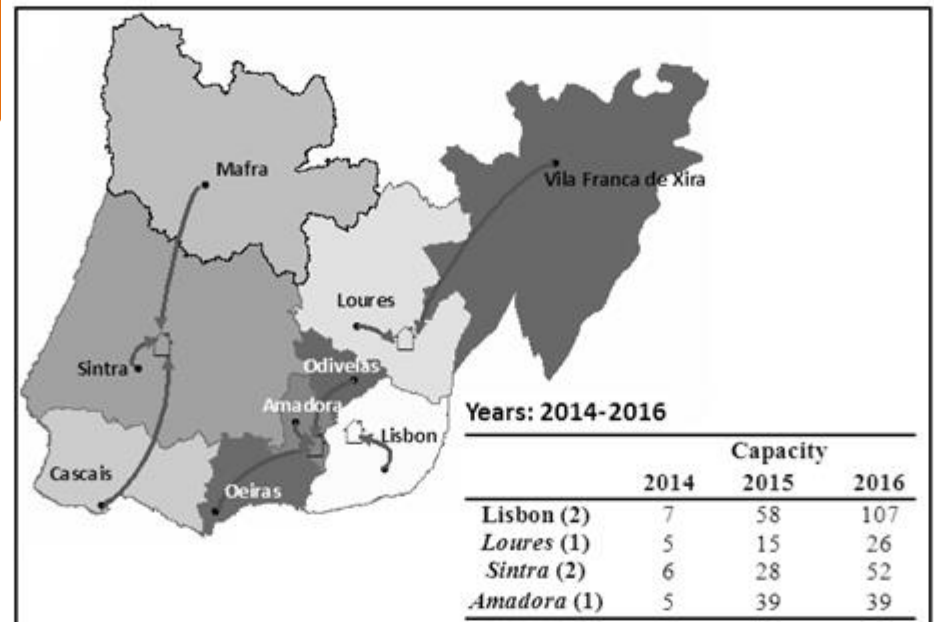
I

**How should the LTC network be reorganized so as to minimize costs and when considering uncertainty in the demand and delivery of LTC?**

- ✓ Closure & Opening of services?
- ✓ Capacity?
- ✓ Allocation of patients?




| | Initial capacity 2013 |
|---|---|
| Lisbon (2) | 6 |
| *Loures* (1) | 30 |
| *Mafra* (1) | 20 |
| *Sintra* (2) | 5 |

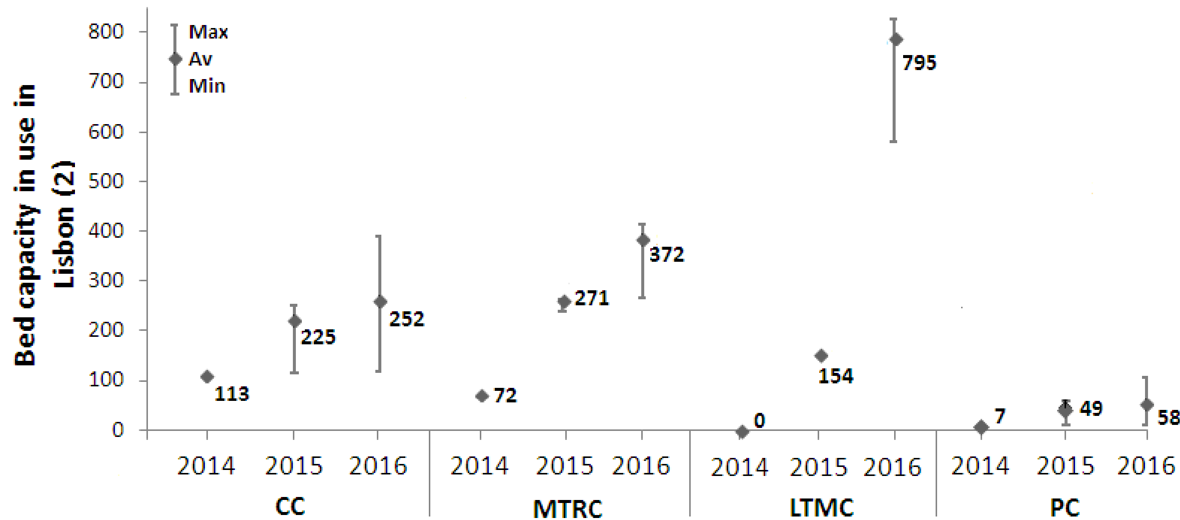



| | Capacity 2014 | 2015 | 2016 |
|---|---|---|---|
| Lisbon (2) | 7 | 58 | 107 |
| *Loures* (1) | 5 | 15 | 26 |
| *Sintra* (2) | 6 | 28 | 52 |
| *Amadora* (1) | 5 | 39 | 39 |

Legend: PC – Palliative care

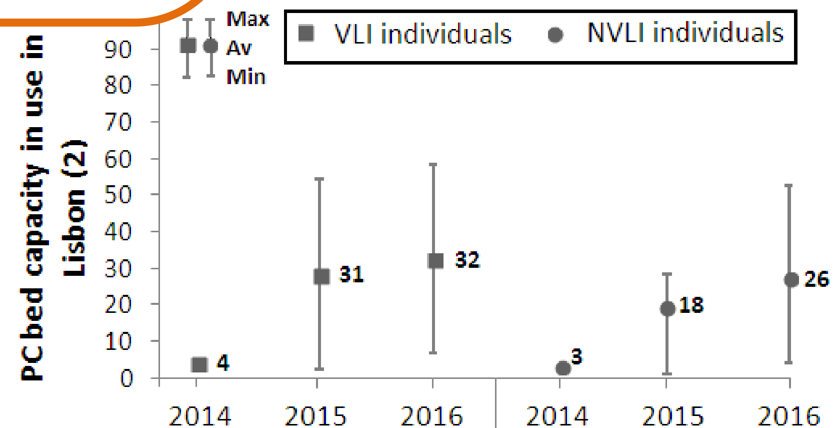
# VI. Case Study: Results

How should the LTC network be reorganized so as to minimize costs and when considering uncertainty in the demand and delivery of LTC?




Legend: VLI – Very Low Income
NVLI – Not Very Low Income

Legend: CC – Convalescence Care
MTRC – Medium-Term and Rehabilitation Care
LTMC – Long-Term and Maintenance Care
PC – Palliative care



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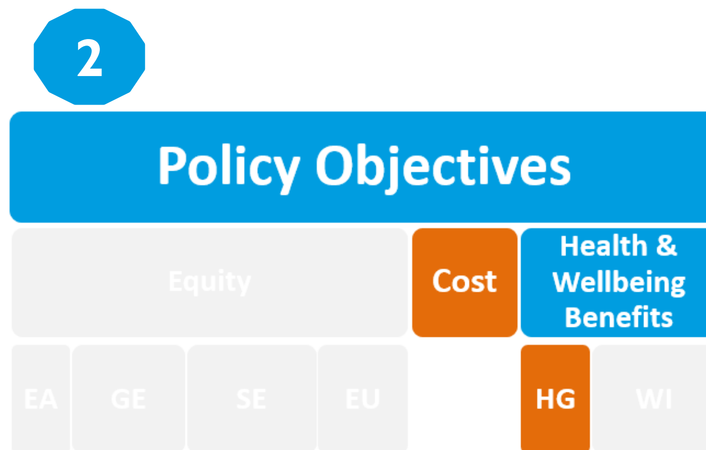
# Results

## How should the LTC network be reorganized when multiple policy objectives are set?



# VI. Case Study: Results

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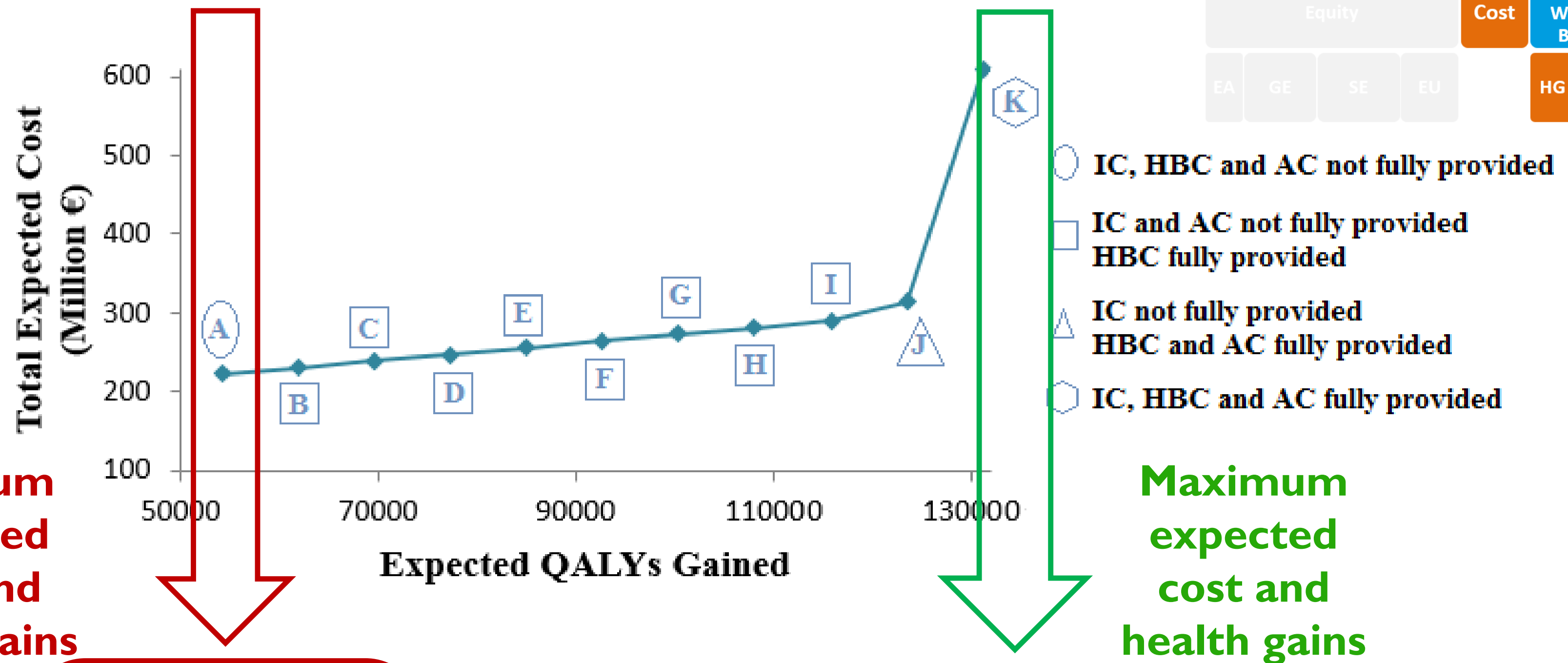
2 How should the LTC network be reorganized when multiple policy objectives are set?



# VI. Case Study: Results

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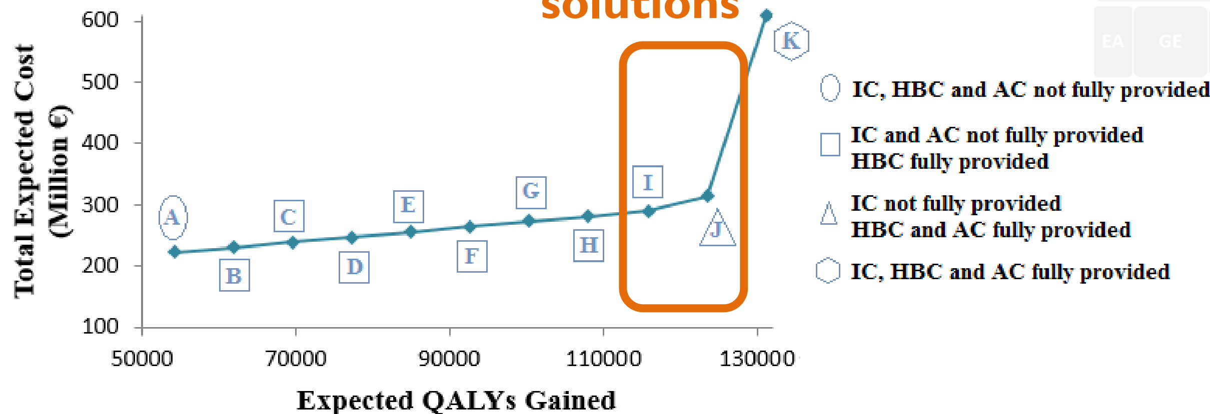
2 **How should the LTC network be reorganized when multiple policy objectives are set?**

Policy Objectives

| Equity | | | | Cost | Health & Wellbeing Benefits | |
|---|---|---|---|---|---|---|
| EA | GE | SE | EU | | HG | WI |

Two most cost-effective solutions




**Extending the LTC network in the Great Lisbon region is cost-effective!**

Threshold (National Institute for Health and Care Excellence): £20,000-£30,000

| Solution | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ICER | 2.83 | 2.58 | 2.40 | 2.25 | 2.14 | 2.05 | 1.97 | 1.90 | 1.81 | 1.86 | 4.19 |

Additional cost (in thousands of euros) per QALY gained, i.e., Incremental Cost Effectiveness Ratios (ICERs), in comparison to the current provision.

# VI. Case Study: Results

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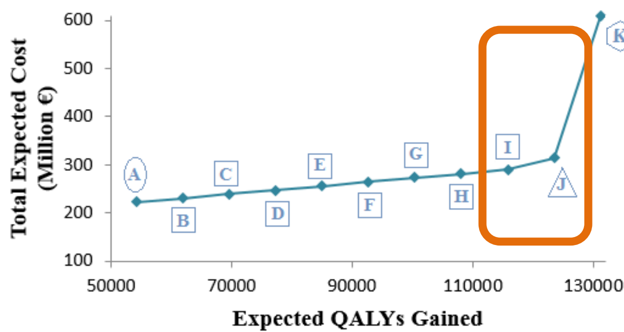
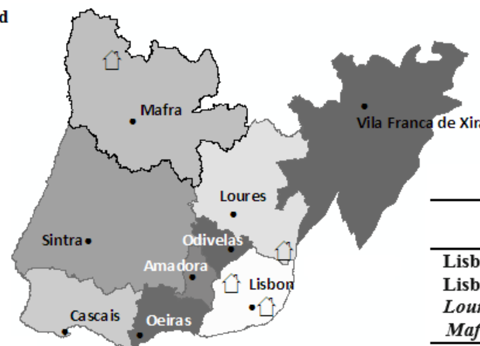
## 2 How should the LTC network be reorganized when multiple policy objectives are set?

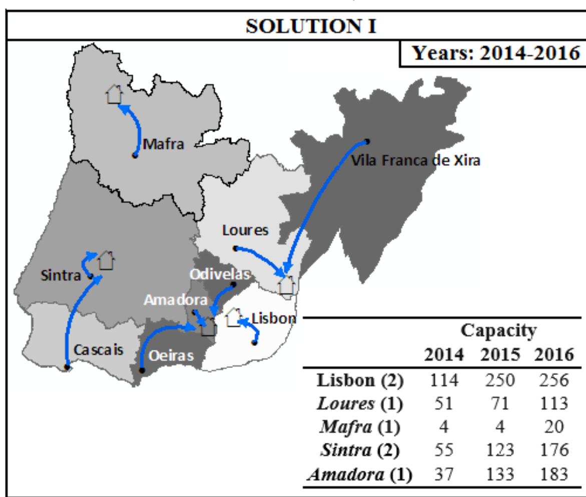


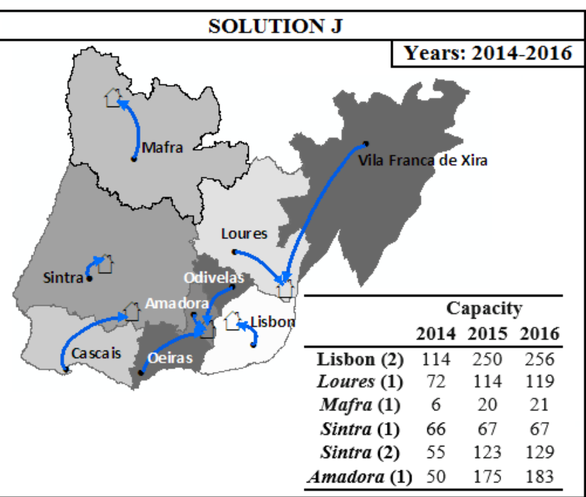

Legend
- CC services
- County

| | Initial capacity 2013 |
|---|---|
| Lisbon (1) | 5 |
| Lisbon (2) | 21 |
| *Loures* (1) | 60 |
| *Mafra* (1) | 50 |

**IC provision under solution I & J**




| | Capacity | | |
|---|---|---|---|
| | 2014 | 2015 | 2016 |
| Lisbon (2) | 114 | 250 | 256 |
| *Loures* (1) | 51 | 71 | 113 |
| *Mafra* (1) | 4 | 4 | 20 |
| *Sintra* (2) | 55 | 123 | 176 |
| *Amadora* (1) | 37 | 133 | 183 |




| | Capacity | | |
|---|---|---|---|
| | 2014 | 2015 | 2016 |
| Lisbon (2) | 114 | 250 | 256 |
| *Loures* (1) | 72 | 114 | 119 |
| *Mafra* (1) | 6 | 20 | 21 |
| *Sintra* (1) | 66 | 67 | 67 |
| *Sintra* (2) | 55 | 123 | 129 |
| *Amadora* (1) | 50 | 175 | 183 |

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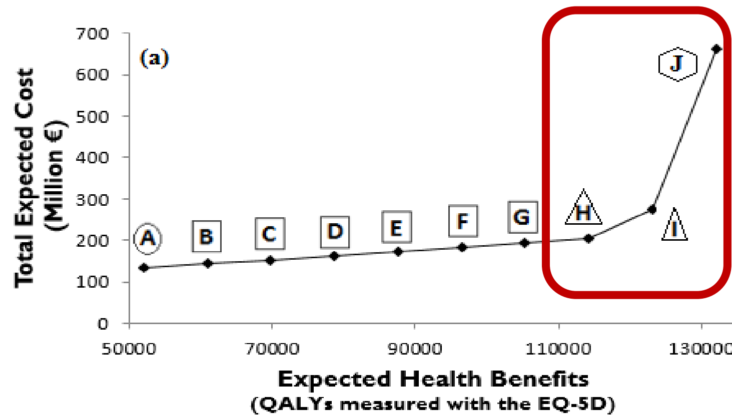
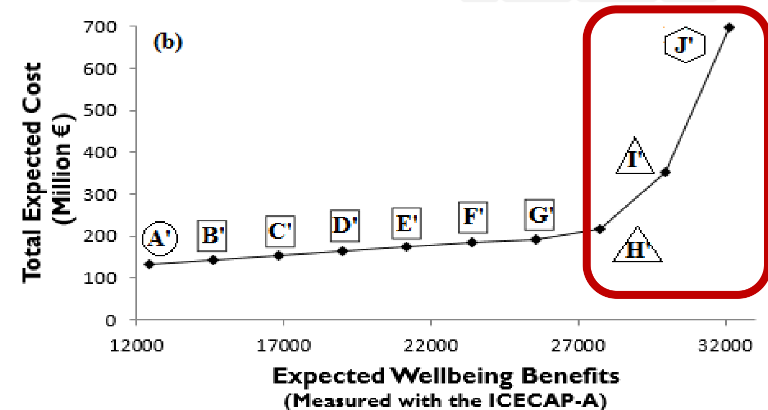
# 3 How should the LTC network be reorganized when multiple policy objectives are set?

Policy Objectives

| Equity | | | | Cost | Health & Wellbeing Benefits | |
|---|---|---|---|---|---|---|
| EA | GE | SE | EU | | HG | WI |




○ IC, HBC and AC not fully provided
△ IC not fully provided HBC and AC fully provided
□ IC and AC not fully provided HBC fully provided
⬡ IC, HBC and AC fully provided

| | |
|---|---|
| 1st | CC |
| 2nd | MTRC |
| 3rd | PC |
| 4th | LTMC |

**Different priorities given to IC services**

| | |
|---|---|
| 1st | PC |
| 2nd | CC |
| 3rd | MTRC |
| 4th | LTMC |

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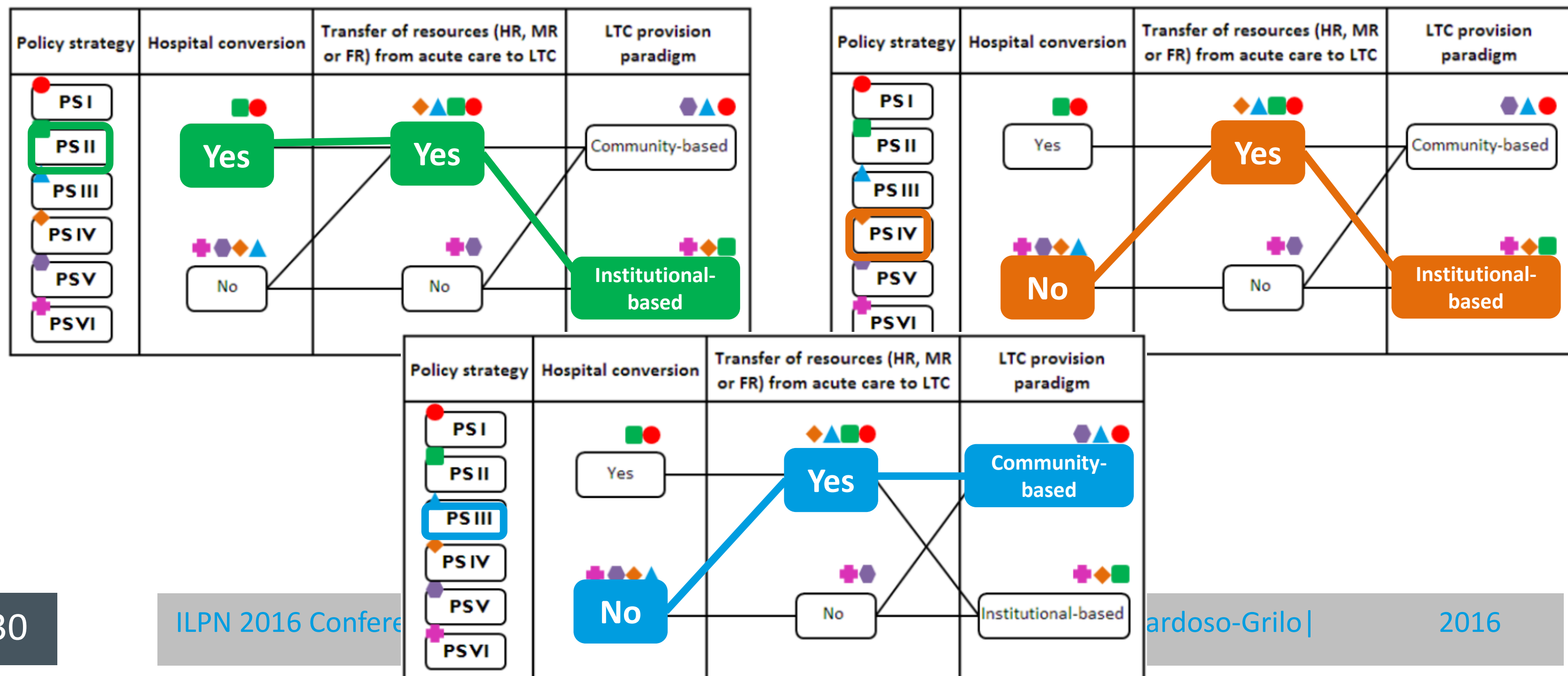
# Results

## 4 What if a variety of policy strategies are adopted?



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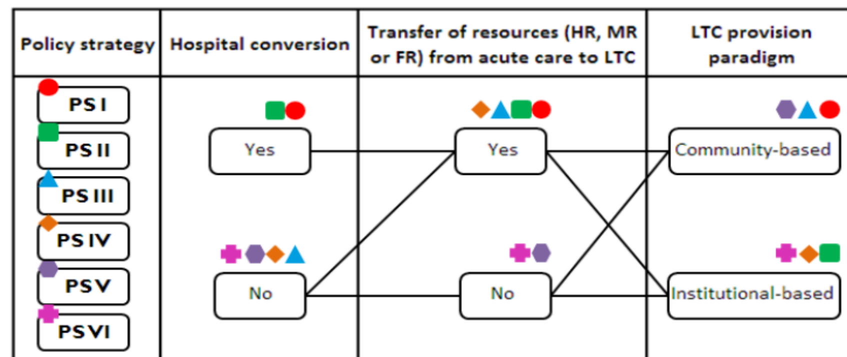
## 4 What if a variety of policy strategies are adopted?

| Policy strategies | Investment costs | Operational costs | Total costs |
|---|---|---|---|
| PS I | €18M | €108M | €126M |
| PS II | €37M | €153M | €190M |
| PS III | €27M | €118M | €145M |
| PS IV | €53M | €170M | €223M |



# VI. Case Study: Results

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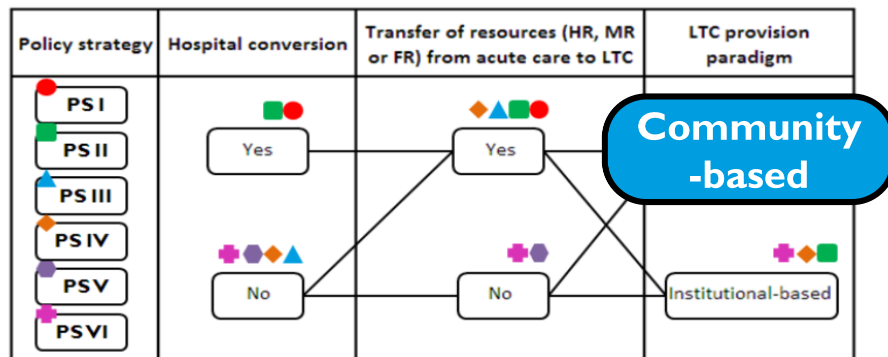
4 What if a variety of policy strategies are adopted?

| Policy strategies | Investment costs | Operational costs | Total costs |
| --- | --- | --- | --- |
| PS I | €18M | €108M | |
| PS II | €37M | €153M | €190M |
| PS III | €27M | €118M | |
| PS IV | €53M | €170M | €223M |

Substitution of institutional care by home-based care is key to reduce costs




Community -based

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## 4 What if a variety of policy strategies are adopted?

| Policy strategies | Investment costs | Operational costs | Total costs |
|---|---|---|---|
| PS I | €18M | | |
| PS II | €37M | €153M | €190M |
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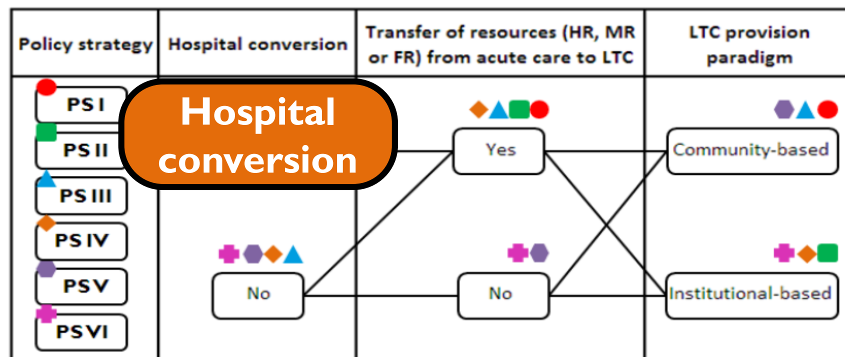
| PS IV | €53M | €170M | €223M |

**Taking advantage of existing structures in the acute care sector for LTC provision results in lower investments in additional capacity**




209 beds from *Maternidade Dr. Alfredo da Costa* used for LTC provision

# VII. Conclusions

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1 Potential for developing the model for decision support.

2 Contribution to literature (combined) – accounts for:

(1) Specificities of LTC;
(2) Multiple policy objectives, including cost, equity, health & wellbeing benefits;
(3) Uncertainty in planning models;
(4) The impact of a variety of health policy options.

3 Results show that:

(1) Investments in the LTC network are cost-effective;
(2) Multiple policy objectives & policy decisions may significantly affect planning decisions in LTC.

A trade-off exists between different policy objectives – different planning decisions arise when considering health or wellbeing benefits.

Investments in the LTC network are more cost-effective under a community-based paradigm and when hospital conversion is allowed.

# VIII. Future research

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1. Developing user-friendly interfaces that facilitate the use of the tool by real planners in he LTC sector.

2. Using Multiple Criteria Decision Making methods to assist decision makers selecting the most preferred solution.

3. Applying the model to other regions in Portugal in collaboration with key players in the LTC sector, such as Regional Health Authorities and the Ministry of Health.

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# Thank you for listening!

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