



# Evaluation of the acceptability of a caring service robot (MARIO)

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# Introduction

Alzheimer' disease (AD), also, leads to severe social consequences:

- decreased quality of life and well-being
  - increased family burdens and health care demand
  - longer term utilization of care facilities
- that generate very significant impacts on health care services demand and consequently costs (Seelye A. et al., 2012).

To fight loneliness and the effects suffered by person with dementia, effective techniques include those that target change of a person's perception of loneliness and those that increase a person's resilience. Resilience is an adaptive capacity that refers to one's ability to 'bounce back' and cope in the face of adversity.



# MARIO Project

(February 2015-January 2018)

Information and Communication Technologies (ICT) solutions can be used to increase psychological skills like resilience (*Norris et al., 2008*), and to manage active and healthy aging with the use of caring service robots as will be explored with the EU funded MARIO project (<http://www.mario-project.eu/portal/>).



# Partners



- National University of Ireland, Galway
- ROBOSOFT
- RU Robot
- Ortelio Ltd
- City of Stockport
- Consiglio Nazionale delle Ricerche
- R2M Solution
- Casa Sollievo della Sofferenza Hospital
- Caretta-Net
- University of Passau

# MARIO objectives 1/2

- To address and make progress on the challenging problems of loneliness, isolation and dementia in older persons through multi-faceted interventions delivered by service robots.
- To conduct near project length interaction with end users and assisted living environments.
- To assist caregivers and physicians in the comprehensive geriatric assessment (CGA) through the use of service robots.
- The use of near state of the art robotic platforms that are flexible, modular friendly, low cost and close to market ready.

# MARIO objectives 2/2

- To make MARIO capable to support and receive “robot applications” similar to the developer and app community for smartphones.
- Through novel advances in machine learning techniques and semantic analysis methods to make MARIO more personable, useful, and accepted by end users (e.g. gain perception of non-loneliness).
- To bring MARIO service robot concepts out of the lab and into industry.

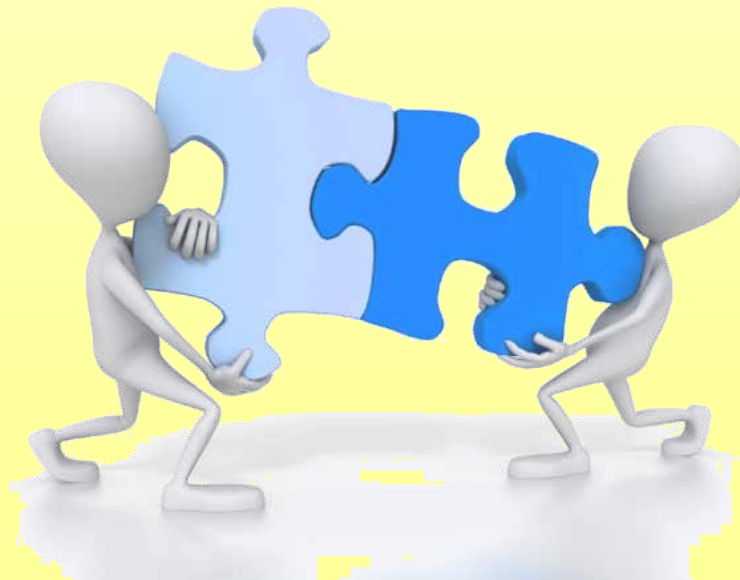
# MARIO Questionnaire

At the first stage of the MARIO project, a questionnaire was designed to find out perceptions of the caregivers about robot companions, especially what they would like such a robot to do for them, and how robots could be designed to build their resilience.



# Aim

The goal of this study was to determine the needs and preferences of formal and informal caregivers for improving the assistance of dementia patients, and guiding the technological development of the MARIO through a questionnaire.





# Material and Methods 1/3

## **130 caregivers of patients with dementia consecutively recruited from May to November 2015 at:**

- Geriatrics Unit, Casa Sollievo della Sofferenza, IRCCS, San Giovanni Rotondo, Italy (**IRCCS**)
- National University of Ireland, Galway, Ireland (**NUIG**)
- Alzheimer Association Bari, Italy (**AAB**)

### **Inclusion criteria:**

- Caregiver of patients with diagnosis of dementia according to the criteria of the National Institute on Aging-Alzheimer's Association (NIAAA)
- The ability to provide an informed consent or availability of a proxy for informed consent.

### **Exclusion criteria:**

- Caregivers of patients with serious comorbidity, tumors and other diseases that could be causally related to cognitive impairment (ascertained blood infections, vitamin B12 deficiency, anaemia, disorders of the thyroid, kidneys or liver), history of alcohol or drug abuse, head trauma, psychoactive substance use and other causes of memory impairment.

# Material and Methods 2/3

The following parameters were collected by a systematic interview about the caregivers:

- **Gender**
- **Age**
- **Educational level** (in years)
- **Caregiving type:**
  - ✓ Informal caregiver (unpaid)
  - ✓ Informal caregiver (paid)
  - ✓ Formal caregiver (Geriatrician)
  - ✓ Formal caregiver (Psychologist)
  - ✓ Formal caregiver (Nurse)

# Material and Methods 3/3

1) A five-minute video on the technological devices and the functions that should be implemented in MARIO

(video weblink: <https://www.youtube.com/watch?v=v1s2Hbad1l0>).

2) A 43-item questionnaire that evaluated the potential role of:

- A) Acceptability
- B) Functionality
- C) Support devices
- D) Impact

3) Responses were expressed as:

- “Extremely important/likely/useful” or “YES, very useful”  
to
- “Not at all important/ likely/useful” or “Not useful at all”.

# Results

**Table 1. Characteristics of dementia caregivers.**

|   | ALL           | NUIG         | IRCCS        | AAB          | P value           |
|---|---------------|--------------|--------------|--------------|-------------------|
|   | N=130         | N=39         | N=70         | N=21         |                   |
| <b>Gender (M/F)</b>                         | 36/55         | -            | 28/42        | 8/13         | 0.876             |
| <b>Age (years)*</b>                         | 48.12 ± 15.81 | -            | 48.74±14.90  | 45.72±19.25  | 0.473             |
| range                                       | 23– 88        |              | 23–88        | 24–82        |                   |
| <b>Educational level (years)*</b>           | 16.09 ± 6.00  | 18.88 ± 1.22 | 14.90 ± 7.06 | 15.61 ± 5.30 | <b>0.006</b>      |
| range                                       | 0– 24         | 18 – 23      | 0 – 23       | 5 – 24       |                   |
| <b>Caregiving types</b>                     |               |              |              |              |                   |
| <i>Informal caregiver (unpaid) N(%)</i>     | 33 (25.3)     | 0 (0)        | 24 (72.7)    | 9 (27.3)     |                   |
| <i>Informal caregiver (paid) N(%)</i>       | 7 (5.4)       | 0 (0)        | 6 (85.7)     | 1 (14.3)     |                   |
| <i>Formal caregiver (Geriatrician) N(%)</i> | 19 (14.6)     | 0 (0)        | 18 (94.7)    | 1 (5.3)      | <b>&lt;0.0001</b> |
| <i>Formal caregiver (Psychologist) N(%)</i> | 7 (5.4)       | 0 (0)        | 0 (0)        | 7 (100.0)    |                   |
| <i>Formal caregiver (Nurse) N(%)</i>        | 57 (43.9)     | 32 (56.1)    | 22 (38.6)    | 3 (5.3)      |                   |
| <i>Not indicated (N%)</i>                   | 7 (5.4)       | 7 (100.0)    | 0 (0)        | 0 (0)        |                   |

\*Values are presented as mean ± standard deviation.

# Results

**Table 2a.** Percentage of responses by caregivers of dementia patients to the MARIO Questionnaire (Section A: Acceptability).

| <i>Items</i>                              | <b>Extremely<br/>important/<br/>likely/useful<br/>N(%)</b> | <b>Very<br/>important/<br/>likely/useful<br/>N(%)</b> | <b>Moderately<br/>important/<br/>likely/useful<br/>N(%)</b> | <b>Slightly<br/>important/<br/>likely/useful<br/>N(%)</b> | <b>Not at all<br/>important/<br/>likely/useful<br/>N(%)</b> |
|---|--|---|---|---|---|
| <b>Section A: ACCEPTABILITY</b>           |  |   |   |   |   |
| <i>1 (Human like appearance)</i>          | 69 (53.5%)   | 33 (25.6 %)   | 22 (17.1%)  | 0 (0 %)   | 5 (3.9%)  |
| <i>2 (Human sounding voice)</i>           | 72 (55.8%)   | 39 (30.2 %)   | 15 (11.6 %)   | 1 (0.8%)  | 2 (1.6%)  |
| <i>3 (Familiar voice)</i>                 | 72 (56.2%)   | 30 (23.4 %)   | 17 (13.3%)  | 4 (3.1%)  | 5 (3.9%)  |
| <i>4 (Covering like to touch)</i>         | 45 (49.5%)   | 29 (31.9 %)   | 14 (15.4%)  | 0 (0%)  | 3 (3.3%)  |
| <i>5 (Height adjustable)</i>              | 55 (43.0%)   | 38 (29.7 %)   | 26 (20.3%)  | 5 (3.9%)  | 4 (3.1%)  |
| <i>6 (Not verbally communication)</i>     | 61 (48.0%)   | 41 (32.3 %)   | 18 (14.2%)  | 2 (1.6%)  | 5 (3.9 %)   |
| <i>7 (displays emotional expression)</i>  | 61 (47.7%)   | 40 (31.6 %)   | 22 (17.2%)  | 0 (0%)  | 5 (3.9%)  |
| <i>8 (Daily assistance reminder)</i>      | 50 (40.0%)   | 31 (24.8%)  | 25 (20.0%)  | 14 (11.2%)  | 5 (4.0%)  |
| <i>9 (Monitor movement)</i>               | 47 (36.7%)   | 25 (19.5%)  | 33 (25.8%)  | 16 (12.5%)  | 7 (5.5%)  |
| <i>10 (Entertainment)</i>                 | 52 (40.9%)   | 35 (27.6%)  | 28 (22.0%)  | 8 (6.3%)  | 4 (3.1%)  |
| <i>11 (Communication with caregivers)</i> | 48 (37.5%)   | 38 (29.7%)  | 23 (18.0%)  | 14 (10.9%)  | 5 (3.9%)  |
| <i>12 (Quiet robot)</i>                   | 53 (42.1%)   | 50 (39.7%)  | 20 (15.9%)  | 0 (0%)  | 3 (2.4%)  |
| <i>13 (Moving in home)</i>                | 60 (46.9%)   | 46 (35.9%)  | 15 (11.7%)  | 3 (2.3%)  | 4 (3.1%)  |
| <i>14 (Internet connection)</i>           | 52 (40.6%)   | 40 (31.2%)  | 23 (18.0%)  | 8 (6.2%)  | 5 (3.9%)  |

# Results

**Table 2b.** Percentage of responses by caregivers of dementia patients to the MARIO Questionnaire (Section B: Functionality).

| <i>Items</i>                           | <b>Extremely<br/>important/<br/>likely/useful<br/>N(%)</b> | <b>Very<br/>important/<br/>likely/useful<br/>N(%)</b> | <b>Moderately<br/>important/<br/>likely/useful<br/>N(%)</b> | <b>Slightly<br/>important/<br/>likely/useful<br/>N(%)</b> | <b>Not at all<br/>important/<br/>likely/useful<br/>N(%)</b> |
|--|--|---|---|---|---|
| <b>Section B: <i>FUNCTIONALITY</i></b> |  |   |   |   |   |
| <i>1 (Face recognition)</i>            | 58 (45.7%)   | 49 (38.6%)  | 13 (10.2%)  | 4 (3.1%)  | 3 (2.4%)  |
| <i>2 (Voice recognition)</i>           | 63 (49.6%)   | 46 (36.2%)  | 14 (11.0%)  | 1 (0.8%)  | 3 (2.4%)  |
| <i>3 (Distinguishing individuals)</i>  | 59 (46.5%)   | 43 (33.1%)  | 22 (17.3%)  | 1 (0.8%)  | 3 (2.4%)  |
| <i>4 (Natural dialogue)</i>            | 63 (49.6%)   | 43 (33.9%)  | 18 (14.2%)  | 0 (0%)  | 3 (2.4%)  |
| <i>5 (Device for outside-home)</i>     | 56 (44.4%)   | 43 (34.1%)  | 17 (13.5%)  | 7 (5.6%)  | 3 (2.4%)  |
| <i>6 (Prompts for appointments)</i>    | 59 (46.8%)   | 45 (35.7%)  | 17 (13.5%)  | 2 (1.6%)  | 3 (2.4%)  |
| <i>7 (Person's life history)</i>       | 59 (46.8%)   | 45 (35.7%)  | 19 (15.1%)  | 0 (0%)  | 3 (2.4%)  |
| <i>8 (Communication by multimedia)</i> | 57 (45.2%)   | 46 (36.5%)  | 20 (15.9%)  | 0 (0%)  | 3 (2.4%)  |
| <i>9 (Voice activation)</i>            | 62 (48.8%)   | 45 (35.4%)  | 17 (13.4%)  | 0 (0%)  | 3 (2.4%)  |
| <i>10 (Gesture recognition)</i>        | 60 (48.4%)   | 45 (36.3%)  | 15 (12.1%)  | 1 (0.8%)  | 3 (2.4%)  |
| <i>11 (Help for walking)</i>           | 50 (40.0%)   | 42 (33.6%)  | 25 (20.0%)  | 1 (0.8%)  | 7 (5.6%)  |
| <i>12 (Understanding dialects)</i>     | 67 (52.8%)   | 37 (29.1%)  | 19 (15.0%)  | 1 (0.8%)  | 3 (2.4%)  |
| <i>13 (GPS function)</i>               | 45 (48.4%)   | 32 (34.4%)  | 12 (12.9%)  | 1 (1.1%)  | 3 (3.2%)  |

# Results

**Table 2c.** Percentage of responses by caregivers of dementia patients to the MARIO Questionnaire (Section C: Support Devices, and Section D: Impact).

| <i>Items</i>                               | <b>YES, very useful</b> | <b>YES, moderately useful</b> | <b>YES, low level of usefulness</b> | <b>Not useful at all</b> |
|--|-------------------------|-------------------------------|-------------------------------------|--------------------------|
| <b>Section C: SUPPORT DEVICES</b>          |                         |                               |                                     |                          |
| <i>1 (Bed rest)</i>                        | 80 (65.0%)              | 28 (22.8%)                    | 13 (10.6%)                          | 2 (1.6%)                 |
| <i>2 (Medication use)</i>                  | 81 (65.9%)              | 25 (20.3%)                    | 14 (11.4%)                          | 3 (2.4%)                 |
| <i>3 (Ambient environmental)</i>           | 80 (65.0%)              | 29 (23.6%)                    | 12 (9.8%)                           | 2 (1.6%)                 |
| <i>4 (Lighting, TV channels)</i>           | 66 (53.7%)              | 37 (30.1%)                    | 16 (13.0%)                          | 4 (3.3%)                 |
| <i>5 (CGA)</i>                             | 60 (48.8%)              | 37 (30.1%)                    | 20 (16.3%)                          | 6 (4.9%)                 |
| <i>6 (Care planning)</i>                   | 65 (52.8%)              | 36 (29.3%)                    | 16 (13.0%)                          | 6 (4.9%)                 |
| <i>7 (Physiological deterioration)</i>     | 70 (57.4%)              | 35 (28.7%)                    | 13 (10.7%)                          | 4 (3.3%)                 |
| <i>8 (Cognitive deterioration)</i>         | 70 (56.9%)              | 35 (28.5%)                    | 15 (12.2%)                          | 3 (2.4%)                 |
| <b>Section D: IMPACT</b>                   |                         |                               |                                     |                          |
| <i>1 (Quality of life)</i>                 | 65 (52.4%)              | 38 (30.6%)                    | 18 (14.5%)                          | 3 (2.4%)                 |
| <i>2 (Quality of care)</i>                 | 65 (52.4%)              | 40 (32.3%)                    | 16 (12.9%)                          | 3 (2.4%)                 |
| <i>3 (Safety)</i>                          | 67 (54.0%)              | 36 (29.0%)                    | 16 (12.9%)                          | 5 (4.0%)                 |
| <i>4 (Emergency communication)</i>         | 80 (64.5%)              | 27 (21.8%)                    | 14 (11.3%)                          | 3 (2.4%)                 |
| <i>5 (Cognitive rehabilitation)</i>        | 71 (57.3%)              | 36 (29.0%)                    | 13 (10.5%)                          | 4 (3.2%)                 |
| <i>6 (Detecting isolation)</i>             | 71 (57.3%)              | 35 (28.2%)                    | 14 (11.3%)                          | 4 (3.2%)                 |
| <i>7 (Detecting health status changes)</i> | 70 (57.4%)              | 34 (27.9%)                    | 15 (12.3%)                          | 3 (2.5%)                 |

# Results

**Table 3a.** Effects of sex and age of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section A: Acceptability)

| Items                              | SEX        |            |                   | AGE         |             |            |              |
|------------------------------------|------------|------------|-------------------|-------------|-------------|------------|--------------|
|                                    | M          | F          | P value           | 20-34 years | 35-49 years | ≥ 50 years | P value      |
| <b>Section A: ACCEPTABILITY</b>    |            |            |                   |             |             |            |              |
| 1 (Human like appearance)          | 24 (66.7%) | 50 (90.9%) | <b>0.004</b>      | 11 (68.8%)  | 29 (85.3%)  | 32 (84.2%) | 0.323        |
| 2 (Human sounding voice)           | 24 (66.7%) | 52 (94.5%) | <b>&lt;0.0001</b> | 13 (81.2%)  | 30 (88.2%)  | 31 (81.6%) | 0.700        |
| 3 (Familiar voice)                 | 29 (80.6%) | 52 (94.5%) | <b>0.037</b>      | 13 (81.2%)  | 31 (91.2%)  | 34 (89.5%) | 0.574        |
| 4 (Covering like to touch)         | 24 (66.7%) | 50 (90.9%) | <b>0.004</b>      | 11 (68.8%)  | 30 (88.2%)  | 32 (84.2%) | 0.224        |
| 5 (Height adjustable)              | 23 (63.9%) | 44 (80.0%) | 0.088             | 9 (56.2%)   | 27 (79.4%)  | 29 (76.3%) | 0.199        |
| 6 (Not verbally communication)     | 25 (69.4%) | 48 (87.3%) | <b>0.037</b>      | 11 (68.8%)  | 27 (79.4%)  | 32 (84.2%) | 0.437        |
| 7 (displays emotional expression)  | 26 (72.2%) | 48 (87.3%) | 0.072             | 12 (75.0%)  | 28 (82.4%)  | 32 (84.2%) | 0.722        |
| 8 (Daily assistance reminder)      | 22 (61.1%) | 43 (78.2%) | 0.078             | 8 (50.0%)   | 26 (76.5%)  | 31 (81.6%) | 0.050        |
| 9 (Monitor movement)               | 23 (63.9%) | 42 (76.4%) | 0.198             | 7 (43.8%)   | 27 (79.4%)  | 30 (78.9%) | <b>0.016</b> |
| 10 (Entertainment)                 | 23 (63.9%) | 44 (80.0%) | 0.088             | 8 (50.0%)   | 28 (82.4%)  | 30 (78.9%) | <b>0.036</b> |
| 11 (Communication with caregivers) | 23 (63.9%) | 46 (83.6%) | <b>0.031</b>      | 9 (56.2%)   | 31 (91.2%)  | 28 (73.7%) | <b>0.018</b> |
| 12 (Quiet robot)                   | 25 (69.4%) | 46 (83.6%) | 0.110             | 10 (62.5%)  | 31 (91.2%)  | 29 (76.3%) | 0.052        |
| 13 (Moving in home)                | 25 (69.4%) | 48 (87.3%) | <b>0.037</b>      | 11 (68.8%)  | 31 (91.2%)  | 30 (78.9%) | 0.132        |
| 14 (Internet connection)           | 24 (66.7%) | 45 (81.8%) | 0.099             | 8 (50.0%)   | 31 (91.2%)  | 29 (76.3%) | <b>0.005</b> |



# Results

**Table 3b.** Effects of sex and age of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section B: Functionality).

| Items                           | SEX        |            |                   | AGE         |             |            |         |
|---------------------------------|------------|------------|-------------------|-------------|-------------|------------|---------|
|                                 | M          | F          | P value           | 20-34 years | 35-49 years | ≥ 50 years | P value |
| <b>Section B: FUNCTIONALITY</b> |            |            |                   |             |             |            |         |
| 1 (Face recognition)            | 24 (66.7%) | 49 (89.1%) | <b>0.009</b>      | 12 (75.0%)  | 27 (79.4%)  | 31 (81.6%) | 0.861   |
| 2 (Voice recognition)           | 27 (75.0%) | 49 (89.1%) | 0.076             | 13 (81.2%)  | 28 (82.4%)  | 32 (84.2%) | 0.959   |
| 3 (Distinguishing individuals)  | 25 (69.4%) | 50 (90.9%) | <b>0.009</b>      | 13 (81.2%)  | 28 (82.4%)  | 32 (84.2%) | 0.959   |
| 4 (Natural dialogue)            | 26 (72.2%) | 51 (92.7%) | <b>0.008</b>      | 13 (81.2%)  | 29 (85.3%)  | 33 (86.8%) | 0.869   |
| 5 (Device for outside-home)     | 25 (69.4%) | 49 (89.1%) | <b>0.019</b>      | 12 (75.0%)  | 27 (79.4%)  | 33 (86.8%) | 0.528   |
| 6 (Prompts for appointments)    | 27 (75.0%) | 50 (90.9%) | <b>0.040</b>      | 12 (75.0%)  | 29 (85.3%)  | 33 (86.8%) | 0.538   |
| 7 (Person’s life history)       | 24 (66.7%) | 49 (89.1%) | <b>0.009</b>      | 10 (62.5%)  | 27 (79.4%)  | 33 (86.8%) | 0.129   |
| 8 (Communication by multimedia) | 25 (69.4%) | 50 (90.9%) | <b>0.009</b>      | 11 (68.8%)  | 28 (82.4%)  | 33 (86.8%) | 0.288   |
| 9 (Voice activation)            | 26 (72.2%) | 48 (87.3%) | 0.072             | 11 (68.8%)  | 29 (85.3%)  | 31 (81.6%) | 0.378   |
| 10 (Gesture recognition)        | 25 (69.4%) | 51 (92.7%) | <b>0.003</b>      | 12 (75.0%)  | 29 (85.3%)  | 32 (84.2%) | 0.641   |
| 11 (Help for walking)           | 22 (61.1%) | 51 (92.7%) | <b>&lt;0.0001</b> | 12 (75.0%)  | 28 (82.4%)  | 30 (78.9%) | 0.829   |
| 12 (Understanding dialects)     | 25 (69.4%) | 49 (89.1%) | <b>0.019</b>      | 13 (81.2%)  | 28 (82.4%)  | 31 (81.6%) | 0.994   |
| 13 (GPS function)               | 24 (66.7%) | 51 (92.7%) | <b>0.001</b>      | 12 (75.0%)  | 30 (88.2%)  | 31 (81.6%) | 0.487   |

# Results

**Table 3c.** Effects of sex and age of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section C: Support Devices, and Section D: Impact).

| Items                               | SEX        |            |                   | AGE         |             |            |              |
|-------------------------------------|------------|------------|-------------------|-------------|-------------|------------|--------------|
|                                     | M          | F          | P value           | 20-34 years | 35-49 years | ≥ 50 years | P value      |
| <b>Section C: SUPPORT DEVICES</b>   |            |            |                   |             |             |            |              |
| 1 (Bed rest)                        | 27 (75.0%) | 52 (94.5%) | <b>0.007</b>      | 13 (81.2%)  | 32 (94.1%)  | 32 (84.2%) | 0.315        |
| 2 (Medication use)                  | 29 (80.6%) | 53 (96.4%) | <b>0.014</b>      | 13 (81.2%)  | 32 (94.1%)  | 35 (92.1%) | 0.317        |
| 3 (Ambient environmental)           | 28 (77.8%) | 52 (94.5%) | <b>0.016</b>      | 13 (81.2%)  | 32 (94.1%)  | 33 (86.8%) | 0.367        |
| 4 (Lighting, TV channels)           | 25 (69.4%) | 52 (94.5%) | <b>0.001</b>      | 12 (75.0%)  | 32 (94.1%)  | 32 (84.2%) | 0.162        |
| 5 (CGA)                             | 26 (72.2%) | 49 (89.1%) | <b>0.039</b>      | 11 (68.8%)  | 32 (94.1%)  | 31 (81.6%) | 0.062        |
| 6 (Care planning)                   | 25 (69.4%) | 49 (89.1%) | <b>0.019</b>      | 10 (62.5%)  | 32 (94.1%)  | 31 (81.6%) | <b>0.020</b> |
| 7 (Physiological deterioration)     | 25 (69.4%) | 53 (96.4%) | <b>&lt;0.0001</b> | 12 (75.0%)  | 32 (94.1%)  | 32 (84.2%) | 0.162        |
| 8 (Cognitive deterioration)         | 27 (75.0%) | 52 (94.5%) | <b>0.007</b>      | 13 (81.2%)  | 32 (94.1%)  | 32 (84.2%) | 0.315        |
| <b>Section D: IMPACT</b>            |            |            |                   |             |             |            |              |
| 1 (Quality of life)                 | 26 (72.2%) | 49 (89.1%) | <b>0.039</b>      | 10 (62.5%)  | 31 (91.2%)  | 32 (84.2%) | <b>0.041</b> |
| 2 (Quality of care)                 | 27 (75.0%) | 51 (92.7%) | <b>0.018</b>      | 12 (75.0%)  | 32 (94.1%)  | 32 (84.2%) | 0.162        |
| 3 (Safety)                          | 27 (75.0%) | 51 (92.7%) | <b>0.018</b>      | 10 (62.5%)  | 32 (94.1%)  | 33 (86.8%) | <b>0.012</b> |
| 4 (Emergency communication)         | 27 (75.0%) | 54 (98.2%) | <b>0.001</b>      | 13 (81.2%)  | 32 (94.1%)  | 33 (86.8%) | 0.367        |
| 5 (Cognitive rehabilitation)        | 28 (77.8%) | 53 (96.4%) | <b>0.006</b>      | 12 (75.0%)  | 31 (91.2%)  | 35 (92.1%) | 0.163        |
| 6 (Detecting isolation)             | 28 (77.8%) | 51 (92.7%) | <b>0.039</b>      | 11 (68.8%)  | 31 (91.2%)  | 34 (89.5%) | 0.074        |
| 7 (Detecting health status changes) | 26 (72.2%) | 52 (94.5%) | <b>0.003</b>      | 11 (68.8%)  | 31 (91.2%)  | 33 (86.8%) | 0.106        |

# Results

**Table 4a.** Effects of educational level of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section A: Acceptability).

| <i>Items</i>                              | <b>Low education</b> | <b>High school diploma</b> | <b>Degree</b> | <b>P value</b> |
|---|----------------------|----------------------------|---------------|----------------|
| <b>Section A: ACCEPTABILITY</b>           |                      |                            |               |                |
| <i>1 (Human like appearance)</i>          | 23 (88.5%)           | 5 (55.6%)                  | 66 (77.6%)    | 0.114          |
| <i>2 (Human sounding voice)</i>           | 22 (84.6%)           | 5 (55.6%)                  | 77 (90.6%)    | <b>0.012</b>   |
| <i>3 (Familiar voice)</i>                 | 24 (92.3%)           | 7 (77.8%)                  | 65 (77.4%)    | 0.236          |
| <i>4 (Covering like to touch)</i>         | 22 (84.6%)           | 6 (66.7%)                  | 45 (84.9%)    | 0.390          |
| <i>5 (Height adjustable)</i>              | 23 (88.5%)           | 5 (55.6%)                  | 59 (69.4%)    | 0.081          |
| <i>6 (Not verbally communication)</i>     | 23 (88.5%)           | 7 (77.8%)                  | 64 (76.2%)    | 0.404          |
| <i>7 (displays emotional expression)</i>  | 24 (92.3%)           | 6 (66.7%)                  | 64 (75.3%)    | 0.124          |
| <i>8 (Daily assistance reminder)</i>      | 24 (92.3%)           | 6 (66.7%)                  | 48 (58.5%)    | <b>0.006</b>   |
| <i>9 (Monitor movement)</i>               | 23 (88.5%)           | 5 (55.6%)                  | 40 (47.1%)    | <b>0.001</b>   |
| <i>10 (Entertainment)</i>                 | 23 (88.5%)           | 7 (77.8%)                  | 54 (63.5%)    | <b>0.046</b>   |
| <i>11 (Communication with caregivers)</i> | 22 (84.6%)           | 4 (44.4%)                  | 57 (67.1%)    | 0.059          |
| <i>12 (Quiet robot)</i>                   | 23 (88.5%)           | 4 (44.4%)                  | 71 (84.5%)    | <b>0.007</b>   |
| <i>13 (Moving in home)</i>                | 22 (84.6%)           | 6 (66.7%)                  | 72 (84.7%)    | 0.378          |
| <i>14 (Internet connection)</i>           | 22 (84.6%)           | 5 (55.6%)                  | 61 (71.8%)    | 0.197          |

# Results

**Table 4b.** Effects of educational level of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section B: Functionality).

| <i>Items</i>                           | <b>Low education</b> | <b>High school diploma</b> | <b>Degree</b> | <b>P value</b> |
|--|----------------------|----------------------------|---------------|----------------|
| <b>Section B: FUNCTIONALITY</b>        |                      |                            |               |                |
| <i>1 (Face recognition)</i>            | 23 (88.5%)           | 6 (66.7%)                  | 71 (83.5%)    | 0.317          |
| <i>2 (Voice recognition)</i>           | 24 (92.3%)           | 6 (66.7%)                  | 72 (84.7%)    | 0.177          |
| <i>3 (Distinguishing individuals)</i>  | 23 (88.5%)           | 8 (88.9%)                  | 66 (77.6%)    | 0.385          |
| <i>4 (Natural dialogue)</i>            | 24 (92.3%)           | 8 (88.9%)                  | 68 (80.0%)    | 0.303          |
| <i>5 (Device for outside-home)</i>     | 24 (92.3%)           | 8 (88.9%)                  | 62 (73.8%)    | 0.097          |
| <i>6 (Prompts for appointments)</i>    | 24 (92.3%)           | 8 (88.9%)                  | 67 (79.8%)    | 0.292          |
| <i>7 (Person’s life history)</i>       | 24 (92.3%)           | 8 (88.9%)                  | 66 (78.6%)    | 0.239          |
| <i>8 (Communication by multimedia)</i> | 24 (92.3%)           | 8 (88.9%)                  | 65 (74.3%)    | 0.193          |
| <i>9 (Voice activation)</i>            | 23 (88.5%)           | 7 (77.8%)                  | 71 (83.5%)    | 0.718          |
| <i>10 (Gesture recognition)</i>        | 23 (88.5%)           | 8 (88.9%)                  | 67 (81.7%)    | 0.654          |
| <i>11 (Help for walking)</i>           | 22 (84.6%)           | 6 (66.7%)                  | 59 (71.1%)    | 0.346          |
| <i>12 (Understanding dialects)</i>     | 23 (88.5%)           | 7 (77.8%)                  | 70 (82.4%)    | 0.687          |
| <i>13 (GPS function)</i>               | 22 (84.6%)           | 6 (66.7%)                  | 47 (85.5%)    | 0.366          |

# Results

**Table 4c.** Effects of educational level of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section A: Acceptability, and Section B: Functionality, Section C: Support Devices, and Section D: Impact).

| <i>Items</i>                               | <b>Low education</b> | <b>High school diploma</b> | <b>Degree</b> | <b>P value</b> |
|--|----------------------|----------------------------|---------------|----------------|
| <b>Section C: SUPPORT DEVICES</b>          |                      |                            |               |                |
| <i>1 (Bed rest)</i>                        | 24 (92.3%)           | 7 (77.8%)                  | 76 (89.4%)    | 0.586          |
| <i>2 (Medication use)</i>                  | 23 (88.5%)           | 9 (100.0%)                 | 71 (83.5%)    | 0.244          |
| <i>3 (Ambient environmental)</i>           | 23 (88.5%)           | 8 (88.9%)                  | 76 (89.4%)    | 0.990          |
| <i>4 (Lighting, TV channels)</i>           | 23 (88.5%)           | 7 (77.8%)                  | 72 (84.7%)    | 0.734          |
| <i>5 (CGA)</i>                             | 23 (88.5%)           | 7 (77.8%)                  | 66 (77.6%)    | 0.476          |
| <i>6 (Care planning)</i>                   | 23 (88.5%)           | 7 (77.8%)                  | 70 (82.4%)    | 0.687          |
| <i>7 (Physiological deterioration)</i>     | 23 (88.5%)           | 7 (77.8%)                  | 73 (86.9%)    | 0.710          |
| <i>8 (Cognitive deterioration)</i>         | 23 (88.5%)           | 7 (77.8%)                  | 73 (85.9%)    | 0.730          |
| <b>Section D: IMPACT</b>                   |                      |                            |               |                |
| <i>1 (Quality of life)</i>                 | 23 (88.5%)           | 8 (88.9%)                  | 70 (81.4%)    | 0.628          |
| <i>2 (Quality of care)</i>                 | 23 (88.5%)           | 8 (88.9%)                  | 72 (83.7%)    | 0.793          |
| <i>3 (Safety)</i>                          | 23 (88.5%)           | 8 (88.9%)                  | 69 (80.2%)    | 0.547          |
| <i>4 (Emergency communication)</i>         | 23 (88.5%)           | 8 (88.9%)                  | 73 (84.9%)    | 0.869          |
| <i>5 (Cognitive rehabilitation)</i>        | 24 (92.3%)           | 9 (100.0%)                 | 71 (82.6%)    | 0.206          |
| <i>6 (Detecting isolation)</i>             | 24 (92.3%)           | 9 (100.0%)                 | 70 (81.4%)    | 0.167          |
| <i>7 (Detecting health status changes)</i> | 23 (88.5%)           | 8 (88.9%)                  | 70 (83.3%)    | 0.768          |

# Results

**Table 5a.** Effects of caregiving types of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section A: Acceptability).

| <i>Items</i>                              | <b>Informal caregiver (unpaid)</b> | <b>Informal caregiver (paid)</b> | <b>Formal caregiver (Geriatr.)</b> | <b>Formal caregiver (Nurse)</b> | <b>Formal caregiver (Psychol.)</b> | <b>P value</b> |
|---|------------------------------------|----------------------------------|------------------------------------|---------------------------------|------------------------------------|----------------|
| <b>Section A: ACCEPTABILITY</b>           |                                    |                                  |                                    |                                 |                                    |                |
| <i>1 (Human like appearance)</i>          | 25 (75.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 41 (73.2%)                      | 6 (85.7%)                          | 0.482          |
| <i>2 (Human sounding voice)</i>           | 24 (72.7%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 51 (91.1%)                      | 7 (100.0%)                         | 0.078          |
| <i>3 (Familiar voice)</i>                 | 29 (87.9%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 40 (72.7%)                      | 7 (100.0%)                         | 0.133          |
| <i>4 (Covering like to touch)</i>         | 24 (72.7%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 21 (84.0%)                      | 6 (85.7%)                          | 0.474          |
| <i>5 (Height adjustable)</i>              | 25 (75.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 40 (71.4%)                      | 2 (28.6%)                          | <b>0.048</b>   |
| <i>6 (Not verbally communication)</i>     | 28 (84.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 42 (76.4%)                      | 5 (71.4%)                          | 0.498          |
| <i>7 (displays emotional expression)</i>  | 27 (81.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 40 (71.4%)                      | 7 (100.0%)                         | 0.213          |
| <i>8 (Daily assistance reminder)</i>      | 26 (78.8%)                         | 6 (85.7%)                        | 13 (68.4%)                         | 32 (60.4%)                      | 1 (14.3%)                          | <b>0.013</b>   |
| <i>9 (Monitor movement)</i>               | 25 (75.8%)                         | 6 (85.7%)                        | 14 (73.7%)                         | 22 (39.3%)                      | 2 (28.6%)                          | <b>0.001</b>   |
| <i>10 (Entertainment)</i>                 | 27 (81.8%)                         | 6 (85.7%)                        | 13 (68.4%)                         | 37 (66.1%)                      | 2 (28.6%)                          | 0.058          |
| <i>11 (Communication with caregivers)</i> | 23 (69.7%)                         | 6 (85.7%)                        | 16 (84.2%)                         | 36 (64.3%)                      | 3 (42.9%)                          | 0.216          |
| <i>12 (Quiet robot)</i>                   | 24 (72.7%)                         | 6 (85.7%)                        | 16 (84.2%)                         | 46 (83.6%)                      | 6 (85.7%)                          | 0.728          |
| <i>13 (Moving in home)</i>                | 25 (75.8%)                         | 6 (85.7%)                        | 16 (84.2%)                         | 48 (85.7%)                      | 5 (71.4%)                          | 0.727          |
| <i>14 (Internet connection)</i>           | 24 (72.7%)                         | 6 (85.7%)                        | 16 (84.2%)                         | 38 (67.9%)                      | 4 (57.1%)                          | 0.506          |

# Results

**Table 5b.** Effects of caregiving types of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section B: Functionality).

| <i>Items</i>                           | <b>Informal caregiver (unpaid)</b> | <b>Informal caregiver (paid)</b> | <b>Formal caregiver (Geriatr.)</b> | <b>Formal caregiver (Nurse)</b> | <b>Formal caregiver (Psychol.)</b> | P value |
|--|------------------------------------|----------------------------------|------------------------------------|---------------------------------|------------------------------------|---------|
| <b>Section B: FUNCTIONALITY</b>        |                                    |                                  |                                    |                                 |                                    |         |
| <i>1 (Face recognition)</i>            | 27 (81.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 48 (85.7%)                      | 6 (85.7%)                          | 0.555   |
| <i>2 (Voice recognition)</i>           | 28 (84.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 48 (85.7%)                      | 7 (100.0%)                         | 0.348   |
| <i>3 (Distinguishing individuals)</i>  | 28 (84.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 44 (78.6%)                      | 6 (85.7%)                          | 0.566   |
| <i>4 (Natural dialogue)</i>            | 29 (87.9%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 44 (78.6%)                      | 7 (100.0%)                         | 0.257   |
| <i>5 (Device for outside-home)</i>     | 29 (87.9%)                         | 7 (100.0%)                       | 13 (68.4%)                         | 40 (72.7%)                      | 6 (85.7%)                          | 0.193   |
| <i>6 (Prompts for appointments)</i>    | 30 (90.9%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 43 (78.2%)                      | 7 (100.0%)                         | 0.163   |
| <i>7 (Person’s life history)</i>       | 30 (90.9%)                         | 7 (100.0%)                       | 13 (68.4%)                         | 45 (81.8%)                      | 5 (71.4%)                          | 0.174   |
| <i>8 (Communication by multimedia)</i> | 30 (90.9%)                         | 7 (100.0%)                       | 13 (68.4%)                         | 43 (78.2%)                      | 6 (85.7%)                          | 0.182   |
| <i>9 (Voice activation)</i>            | 28 (84.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 48 (85.7%)                      | 6 (85.7%)                          | 0.551   |
| <i>10 (Gesture recognition)</i>        | 29 (87.9%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 43 (81.1%)                      | 7 (100.0%)                         | 0.301   |
| <i>11 (Help for walking)</i>           | 26 (78.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 36 (66.7%)                      | 7 (100.0%)                         | 0.139   |
| <i>12 (Understanding dialects)</i>     | 27 (81.8%)                         | 7 (100.0%)                       | 14 (73.7%)                         | 48 (85.7%)                      | 6 (85.7%)                          | 0.555   |
| <i>13 (GPS function)</i>               | 25 (75.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 24 (88.9%)                      | 5 (71.4%)                          | 0.410   |

# Results

**Table 5c.** Effects of caregiving types of the caregivers of dementia patients on the “Extremely important/likely/useful” and “Very important/likely/useful responses” to the MARIO Questionnaire (Section C: Support Devices, and Section D: Impact).

| <i>Items</i>                               | <b>Informal caregiver (unpaid)</b> | <b>Informal caregiver (paid)</b> | <b>Formal caregiver (Geriatr.)</b> | <b>Formal caregiver (Nurse)</b> | <b>Formal caregiver (Psychol.)</b> | P value      |
|--|------------------------------------|----------------------------------|------------------------------------|---------------------------------|------------------------------------|--------------|
| <b>Section C: SUPPORT DEVICES</b>          |                                    |                                  |                                    |                                 |                                    |              |
| <i>1 (Bed rest)</i>                        | 27 (81.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 50 (89.3%)                      | 7 (100.0%)                         | 0.498        |
| <i>2 (Medication use)</i>                  | 30 (90.9%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 45 (80.4%)                      | 7 (100.0%)                         | 0.344        |
| <i>3 (Ambient environmental)</i>           | 28 (84.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 50 (89.3%)                      | 7 (100.0%)                         | 0.621        |
| <i>4 (Lighting, TV channels)</i>           | 26 (78.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 46 (82.1%)                      | 7 (100.0%)                         | 0.494        |
| <i>5 (CGA)</i>                             | 26 (78.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 43 (76.8%)                      | 7 (100.0%)                         | 0.367        |
| <i>6 (Care planning)</i>                   | 26 (78.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 47 (83.9%)                      | 4 (57.1%)                          | 0.298        |
| <i>7 (Physiological deterioration)</i>     | 27 (81.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 47 (85.5%)                      | 7 (100.0%)                         | 0.589        |
| <i>8 (Cognitive deterioration)</i>         | 27 (81.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 47 (83.9%)                      | 7 (100.0%)                         | 0.588        |
| <b>Section D: IMPACT</b>                   |                                    |                                  |                                    |                                 |                                    |              |
| <i>1 (Quality of life)</i>                 | 28 (84.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 49 (86.0%)                      | 2 (28.6%)                          | <b>0.002</b> |
| <i>2 (Quality of care)</i>                 | 28 (84.8%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 48 (84.2%)                      | 5 (71.4%)                          | 0.697        |
| <i>3 (Safety)</i>                          | 29 (87.9%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 46 (80.7%)                      | 4 (57.1%)                          | 0.238        |
| <i>4 (Emergency communication)</i>         | 29 (87.9%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 47 (82.5%)                      | 7 (100.0%)                         | 0.549        |
| <i>5 (Cognitive rehabilitation)</i>        | 31 (93.9%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 47 (82.5%)                      | 5 (71.4%)                          | 0.309        |
| <i>6 (Detecting isolation)</i>             | 31 (93.9%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 48 (84.2%)                      | 3 (42.9%)                          | <b>0.010</b> |
| <i>7 (Detecting health status changes)</i> | 29 (87.9%)                         | 7 (100.0%)                       | 16 (84.2%)                         | 47 (85.5%)                      | 4 (57.1%)                          | 0.217        |



# Conclusion



Finally, the collected data show a satisfactory integration between the patient and the system along with a great level of acceptability of MARIO by the end-user, both the patients themselves and the caregivers or medical providers, those who, day by day, take care and assist their patients.

# Thank you!

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- Contact

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