ARMED

ADVANCED RISK MODELLING FOR EARLY DETECTION

Prevention in Action

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HAS technology group

The Frailty Conundrum

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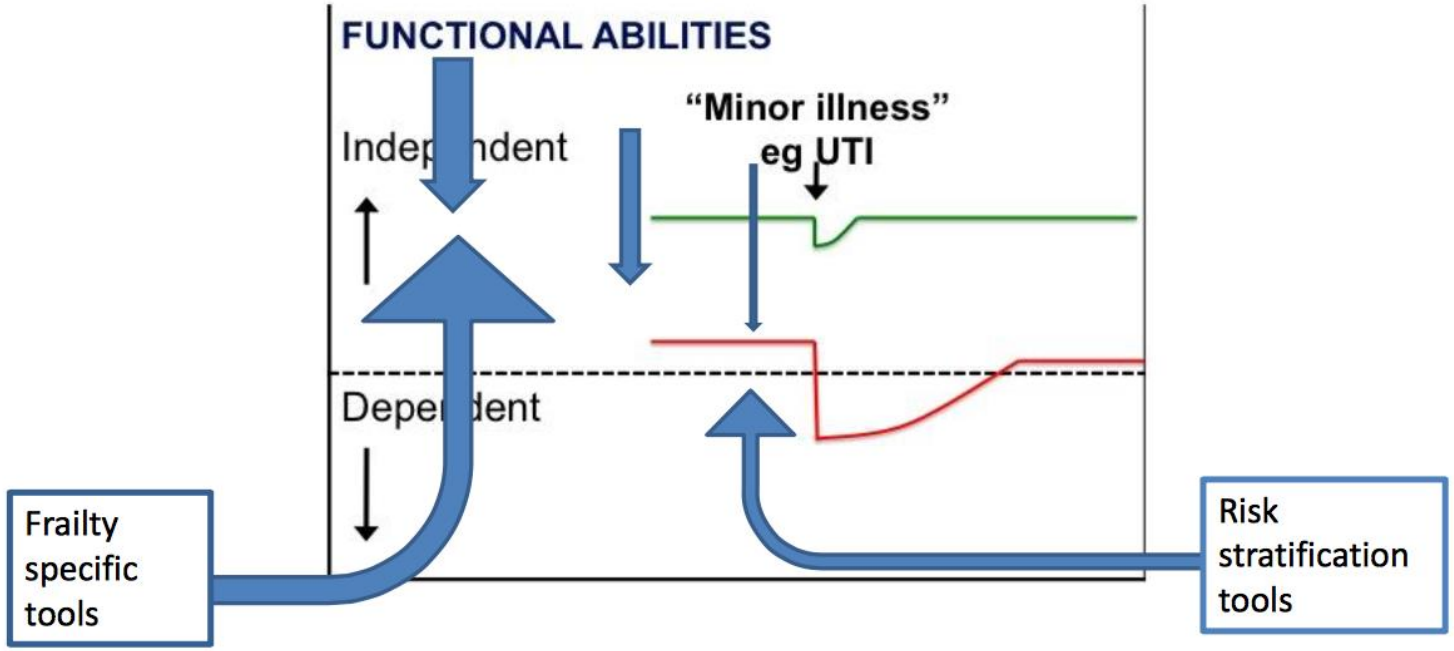
Frailty as an abnormal health state

(Loss of physiological reserve)



Clegg, Young, Iliffe, Olde-Rikkert, Rockwood. Frailty in elderly people. Lancet 2013; 381: 752-762

Demographic and Societal Challenges

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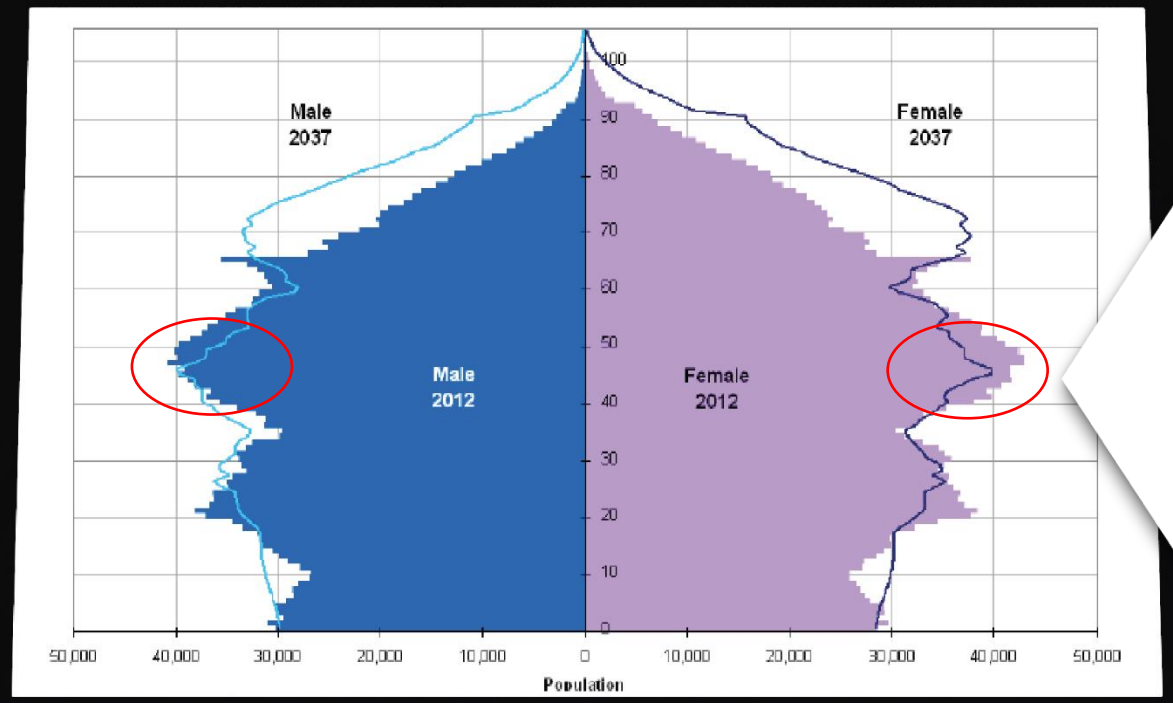

	Males – Least deprived	Males – Most deprived	Female – Least deprived	Female – Most deprived
Life Expectancy (years)	81.7	71.3	84	77.2
Healthy Life expectancy (years)	69.1	48.3	71.9	51.5
Expected years of "Ill health"	12.6	23	12.1	25.7

Source: ISD

Why…?

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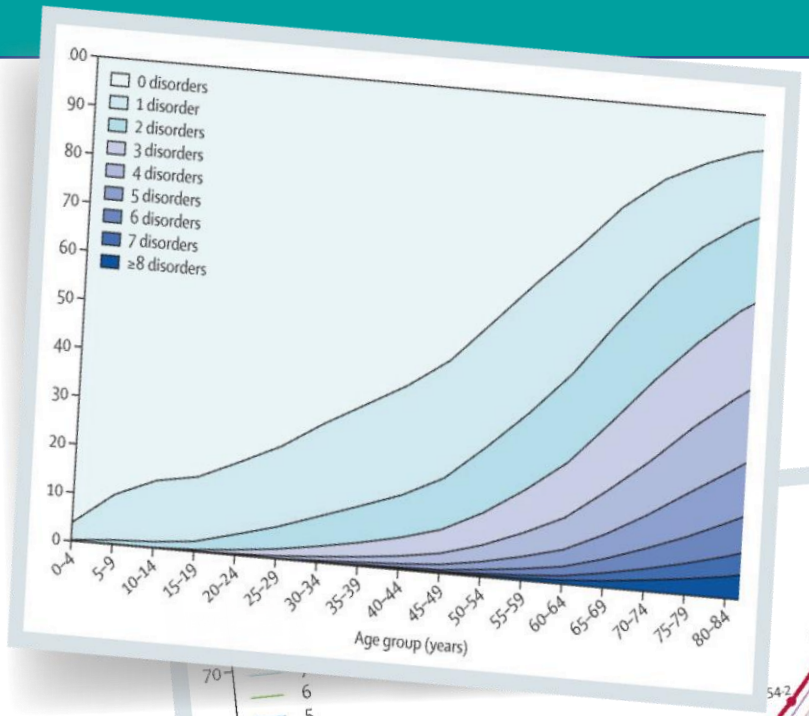

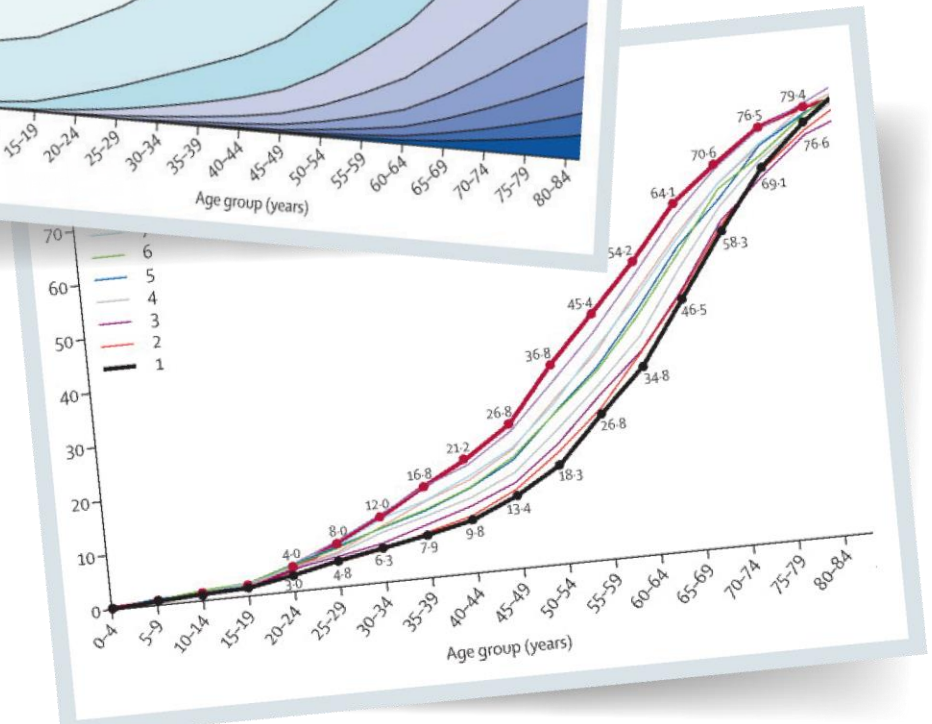

- Demographics – Health & Social Status

4% of all service users (approximately 38,500 individuals) account for 50% of total Scottish healthcare expenditure (ISD Scotland, 2016). These are mainly frail, elderly individuals.

Single-Disease Framework issue – Multimorbidity: **Number of Chronic disorders by age group**

Prevalence of multimorbidity by age and socioeconomic status

Impact of 10 Days of Bed Rest

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Journal of Gerontology: MEDICAL SCIENCES
2008, Vol. 63A, No. 10, 1076–1081

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Functional Impact of 10 Days of Bed Rest in Healthy Older Adults

Patrick Kortebein,[1,2] T. Brock Symons,[3] Arny Ferrando,[1] Douglas Paddon-Jones,[4] Ola Ronsen,[4,5] Elizabeth Protas,[4] Scott Conger,[6] Juan Lombeida,[1] Robert Wolfe,[1] and William J. Evans[1,2]

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[5]Norwegian Olympic Sports Center, Oslo, Norway.
[6]Georgia Institute of Technology, Atlanta.

Background. Many older individuals decline functionally during hospitalization, and the deleterious consequences of bed rest may be one cause. This study reports on the effect of 10 days of bed rest on multiple functional parameters in healthy older adults.

Methods. Healthy older men and women ($n = 11$, 67 ± 5 years old) remained on bed rest for 10 days continuously, and consumed a eucaloric diet providing the Recommended Dietary Allowance for protein. Measures of lower extremity strength and power, aerobic capacity and physical performance, as well as physical activity were performed before and after bed rest.

Results. All measures of lower extremity strength were significantly lower after bed rest including isotonic knee extensor strength (−13.2 ± 4.1%, $p = .004$) and stair-climbing power (−14 ± 4.1%, $p = .01$). Maximal aerobic capacity was 12% lower after bed rest ($p = .04$), whereas measures of physical performance (Short Physical Performance Battery, and a five-item physical performance test) were not significantly different. Voluntary physical activity decreased after bed rest, and the percentage of time spent inactive increased (7.6 ± 1.8%, $p = .004$). There were no medical complications.

Conclusions. In healthy older adults, 10 days of bed rest results in a substantial loss of lower extremity strength, power, and aerobic capacity, and a reduction in physical activity, but has no effect on physical performance. Identification of interventions to maintain muscle function during hospitalization or periods of bed rest in older adults should be a high priority.

Key Words: Aging—Geriatric—Bed rest—Strength—Power—Aerobic capacity—Function.

HOSPITALIZATION results in a substantial decline in functional status in older adult patients; between 30% and 55% of older patients demonstrate a decline in activities of daily living and up to 65% in ambulatory function during hospitalization (1–6). Not infrequently, this decline in function results in nursing home placement (4,5). This is an important issue as older adults represent the majority of hospitalized patients (7) and the number of older adults is projected to double by 2030 (8).

Physical inactivity or bed rest during hospitalization has been proposed as a primary factor contributing to the functional decline of older hospitalized patients (9,10). Recently, we reported that healthy older adults lose almost 1 kg of lean tissue from the lower extremities after 10 days of bed rest, with an associated 16% decline in isokinetic knee extensor strength (11). This marked loss of muscle mass and strength is greater than that observed in young adults after 14 or 28 days of bed rest (12,13). These results are remarkable in that one could hypothesize that these older persons would lose less muscle with bed rest than would their young counterparts because older individuals, in general, have less muscle mass and are less physically active at baseline. In addition to a loss of muscle mass and strength, previous bed rest studies in younger persons have noted a significant decline in aerobic capacity (14,15). No previous studies have specifically examined the independent effect of bed rest on aerobic capacity and physical performance in older adults. This article expands on the results of our previous findings (11) and describes the functional impact of 10 days of bed rest in healthy older men and women, including lower extremity strength and power, maximal aerobic capacity, physical performance, and daily physical activity.

Methods

Participants

Healthy, older (60–85 years old) men and women ($n = 6$ each) were recruited from the communities of Little Rock, Arkansas, and Galveston, Texas. Their average age was 67 ± 5 years (range 62–75 years), with mean body mass index of 29 ± 3 kg/m^2. A medical history and physical examination were performed on each potential participant, as well as routine blood and urine analysis, and a maximal exercise stress test. Exclusion criteria included a positive exercise stress test, history of deep vein thrombosis (DVT)/

Downloaded from https://academic.oup.com/biomedgerontology/article-abstract/63/10/1076/659225 by Reading Borough Council user on 12 April 2019

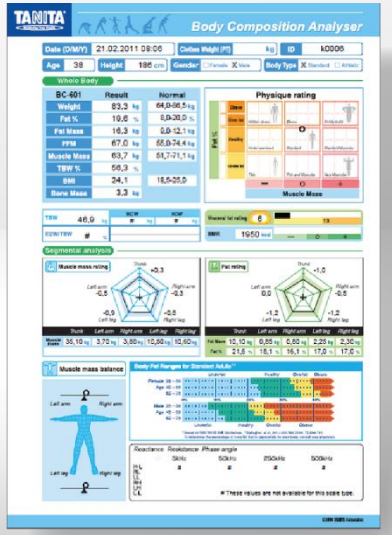
Kortebein et al. (2008)

- Significant de-generation in a person as part of bed rest
- This therefore increases risk of risk escalation following discharge
- Increases likelihood of further exacerbation of adverse events such as further falls

What we are using…

Measurements

- Weight
- Segmental body fat %
- Segmental muscle mass
- Body fat % (age 5 – 99 years)
- Healthy body fat indicator
- Total body water %
- Muscle mass in kg
- Bone mineral mass
- Visceral fat indicator
- Daily Calorie Intake
- Metabolic age
- BMI



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Identifying Escalating Risk

The Story of Person 10

Edinburgh Napier UNIVERSITY

DIGITAL HEALTH & CARE INSTITUTE

Polar Wearables – Data Metrics – 10

Date	Resting	Sitting	Low	medium	high	Total sleep	restfull sleep	Restless sleep	inactivity stamps	Distance walked	Steps taken	How is service user feeling today
01/03/2016	6h 33min	14h 55min	2h 31min	0	0	2h 40mins	2h 5mins	34mins	4	0.65mi	2346	Not so good
02/03/2016	6h 49min	14 48min	2h 23min	0	0	5h 8mins	3h 53mins	1h 15mins	3	0.58mi	2112	Okay
03/03/2016	6h 13min	14h 41min	2h 42min	0	0	4h 30mins	3h 18mins	1h 12mins	1	0.65mi	2346	Okay
04/03/2016	6h 42min	14h 59min	2h 18min	0	0	2h 14mins	1h 46mins	28mins	3	0.56mi	2048	n/a
05/03/2016	7h 2min	12h 5min	1h 54min	0	0	2h 19mins	1h 48mins	30mins	3	0.49mi	1780	n/a
06/03/2016	7h 1min	15h 3min	1h 55mi	0	0	3h 59min	2h 37min	1h 22min	3	0.47mi	1714	Okay
07/03/2016	6h 29min	14h 43min	2h 47min	0	0	3h 27min	2h 40min	46min	2	0.71mi	2562	Not so good
08/03/2016	6h 36min	15h 6min	2h 17min	0	0	6h 6min	3h 53min	2h 13min	4	0.59mi	2136	Okay
09/03/2016	4h 38min	16h 55min	2h 26min	0	0	2h 57min	2h 0min	56min	2	0.60mi	2287	Not so good
10/03/2016	4h 31min	16h 53min	2h 35min	0	0	3h 11min	2h 3min	1h 8min	3	0.69mi	2514	Okay
11/03/2016	7h 19min	14h 42min	1h 50min	0	0	4h 58min	3h 4min	1h 53min	3	0.47mi	1724	Okay
12/03/2016	5h 15min	16h 34min	2h 10min	0	0	2h 3min	1h 1min	1h 2min	4	0.56mi	2032	Not so good
13/03/2016	6h 53min	15h 8min	1h 58min	0	0	3h 22min	2h 49min	33min	4	0.56mi	2014	Not so good
14/03/2016	5h 32min	12h 18min	2h 22min	0	0	n/a	n/a	n/a	0	0.60mi	2174	Not so good
15/03/2016	5h 28min	15h 40min	2h 40min	0	0	1h 49min	1h 23min	25min	3	0.85mi	3028	Okay
16/03/2016	6h 52min	14h 31min	2h 36min	0	0	2h 31min	2h 10min	20min	3	0.70mi	2520	Okay
17/03/2016	7h 6min	14h 24min	2h 30min	0	0	6h 43min	4h 44min	1h 59min	3	0.77mi	2788	Okay
18/03/2016	9h 30min	12h 31min	1h 42min	0	0	3h 7min	2h 12mins	55mins	2	0.48mi	1730	Okay
19/03/2016	8h 51min	13h 8min	2h 0min	0	0	6h 4min	4h 34min	1h 29min	1	0.57mi	2056	Okay
20/03/2016	4h 57min	16h 46min	2h 16min	0	0	2h 24min	1h 34min	50min	3	0.60mi	2176	Not so good
21/03/2016	5h 37min	13h 56min	1h 47min	0	0	4h 30mins	3h 31min	58min	2	0.52mi	1866	Okay
22/03/2016	7h 1min	13h 52min	3h 6min	0	0	5h 51min	3h 37min	2h 13min	1	0.81mi	2944	Okay
23/03/2016	5h 53min	15h 27min	2h 31min	0	0	4h 8min	3h 25min	43min	2	0.69mi	2468	Okay
24/03/2016	7h 33min	13h 29min	2h 48min	0	0	3h 46min	3h 33min	13min	2	0.84mi	2990	n/a
25/03/2016	5h 52min	15h 53min	2h 14min	0	0	3h 13min	2h 11min	1h 2min	2	0.65mi	2312	n/a
26/03/2016	5h 0min	16h 57min	2h 2min	0	0	n/a	n/a	n/a	3	0.58mi	2120	n/a
27/03/2016	5h 22min	15h 31min	2h 6min	0	0	1h 39min	1h 12min	26min	3	0.55mi	1986	n/a
28/03/2016	6h 41min	13 34min	2h 39min	0	0	4h 46min	3h 19min	1h 26min	4	0.72mi	2592	n/a
30/03/2016	0h 37min	7h 12min	1h 16min	0	0	n/a	n/a	n/a	1	0.37mi	1296	n/a
31/03/2016	8h 14min	13h 56min	1h 49min	0	0	4h 5min	2h 51min	1h 13min	3	0.51mi	1844	n/a

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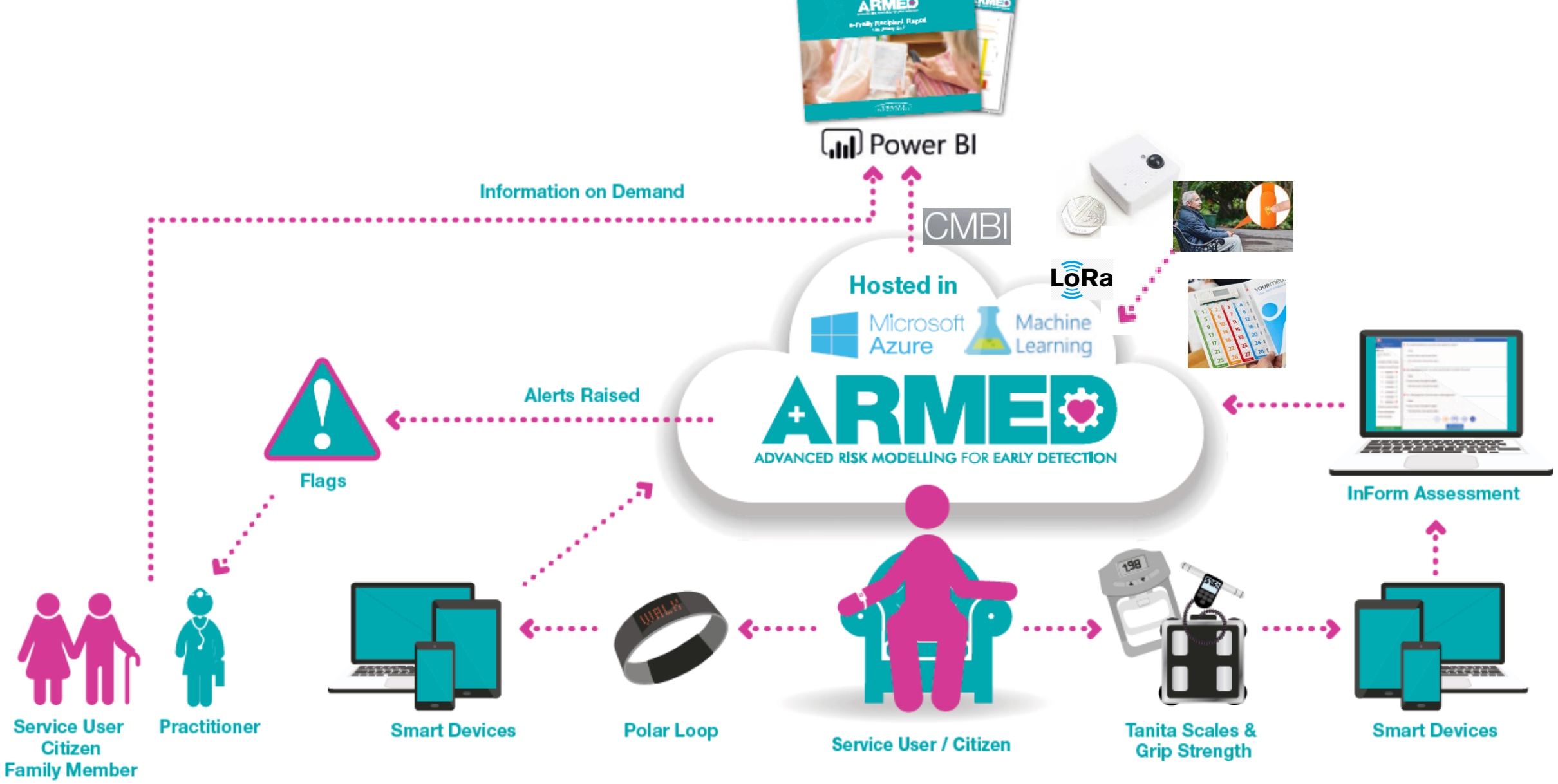

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Loreburn Housing Association
ARMED Pilot
2017 – 5 Months

(Nithsdale Locality)

Participants

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- Those selected to take part in the pilot were volunteers who met the criteria of being at risk of falling or having a history of falls:
- 11 Loreburn customers took part in the pilot
- 5 female and 6 males
- Individuals lived within two separate “very sheltered” housing complexes
- The age range of customers was 60 – 90 years of age
- All of those who took part had 1 or more pre-existing long term health condition
- 8 use a walking aid
- 8 are at risk of falling and 1 classed as borderline risk
- 7 have had a previous fall which required medical treatment or admission to hospital
- 7 are in receipt of care packages ranging from 2 to 4 visits per day

Pilot Outputs

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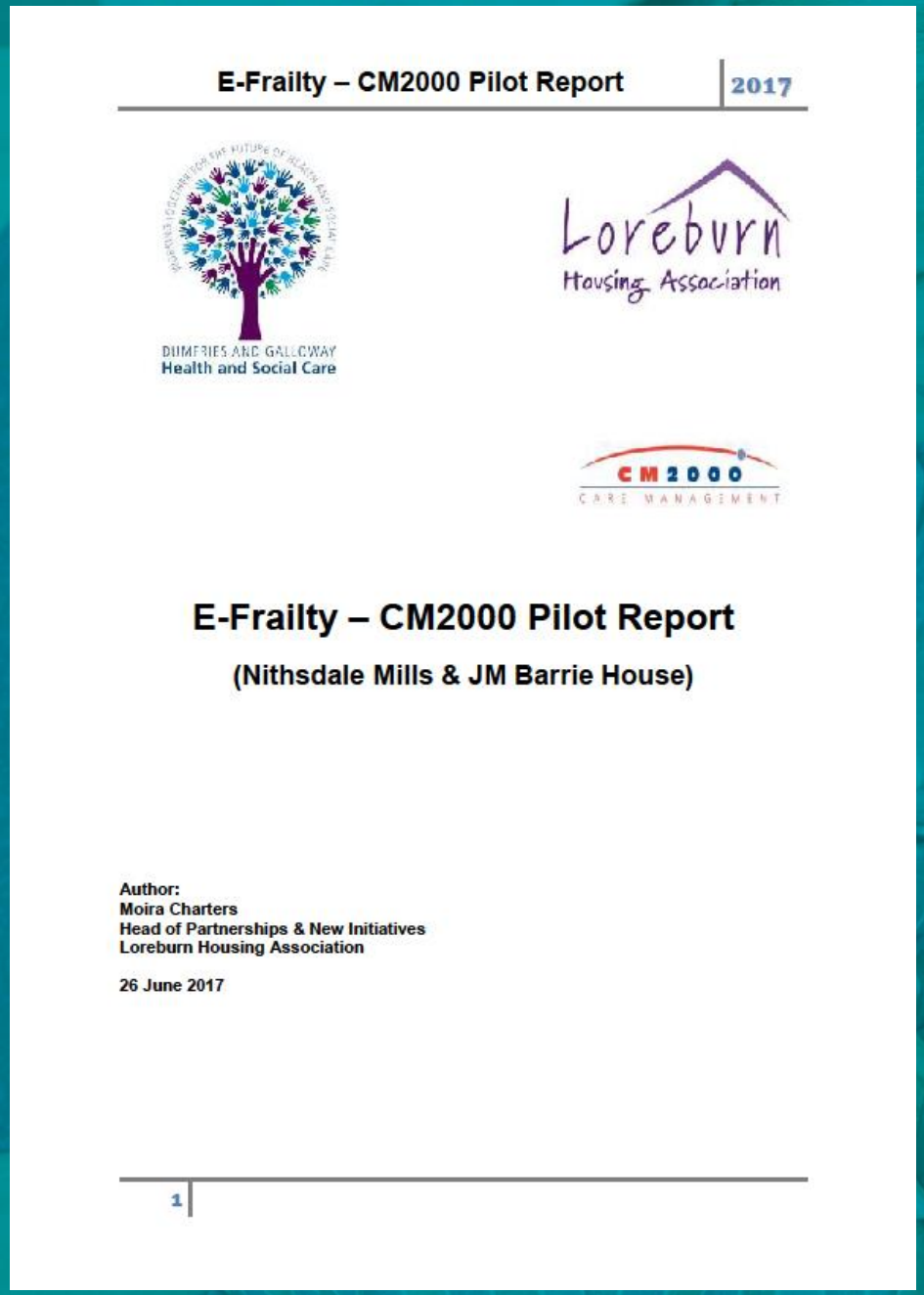
Throughout the course of the research pilot none of the participants had a fall and therefore did not require medical or hospitalisation

- The research pilot was a positive experience for all those who took part
- Those taking part in the pilot became more active and more aware of their exercise habits
- Challenge each other to add more steps the next day
- Highlighted to them how often and how easy it was to spend much of the day seated or resting
- The information allowed more targeted exercise programmes through “Lets Get Sporty”
- Customers began to notice the correlation between increased amounts of exercise and their ability to have a restful nights sleep
- Customer was found to have a decreased heart rate at a similar time each day. GP intervention that previously would have went unnoticed



E-Frailty – CM2000 Pilot Report 2017

DUMFRIES AND GALLOWAY Health and Social Care

Loreburn Housing Association

CM2000 CARE MANAGEMENT

E-Frailty – CM2000 Pilot Report

(Nithsdale Mills & JM Barrie House)

Author:
Moira Charters
Head of Partnerships & New Initiatives
Loreburn Housing Association

26 June 2017

1

Wider Rollout of ARMED commenced in May 2018

ARMED use Within Loreburn HA

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- Reported falls since May 2018 (reported as @ 20/11/18) where ARMED **not deployed**

	Number of Reported Falls	Number of Unique Individual Fallers	GP Visit	Ambulance Called	Social Care Package Instigated
Sheltered Development 1	30	9	11	16	9
Sheltered Development 2	13	5	2	3	3
Sheltered Development 3	9	5	2	2	3
Sheltered Development 4	7	3	0	0	0
Total	**59**	**22**	**15**	**21**	**15**

- Establishments 1-4 (where ARMED has yet to be deployed), there has been 59 reported falls in this timeframe of 22 unique people
- There has been a lot of statutory service involvement of GP callout's, ambulances called, and packages of care put into place. This has conservatively costed at **approximately £200,000***

How many falls has there been within Sheltered Development 5 where ARMED has been deployed? **ZERO!!!**

- In development 5 where we have the ARMED solution rolled out there has been zero falls. The cost of the ARMED solution over the same period would be **approximately £8,000**
- The ARMED solution in this example would represent a significant return in investment in the region of **25: 1** save to spend ratio

Patient 10 - Data Visualisation Following Recent Data Re-Analysis

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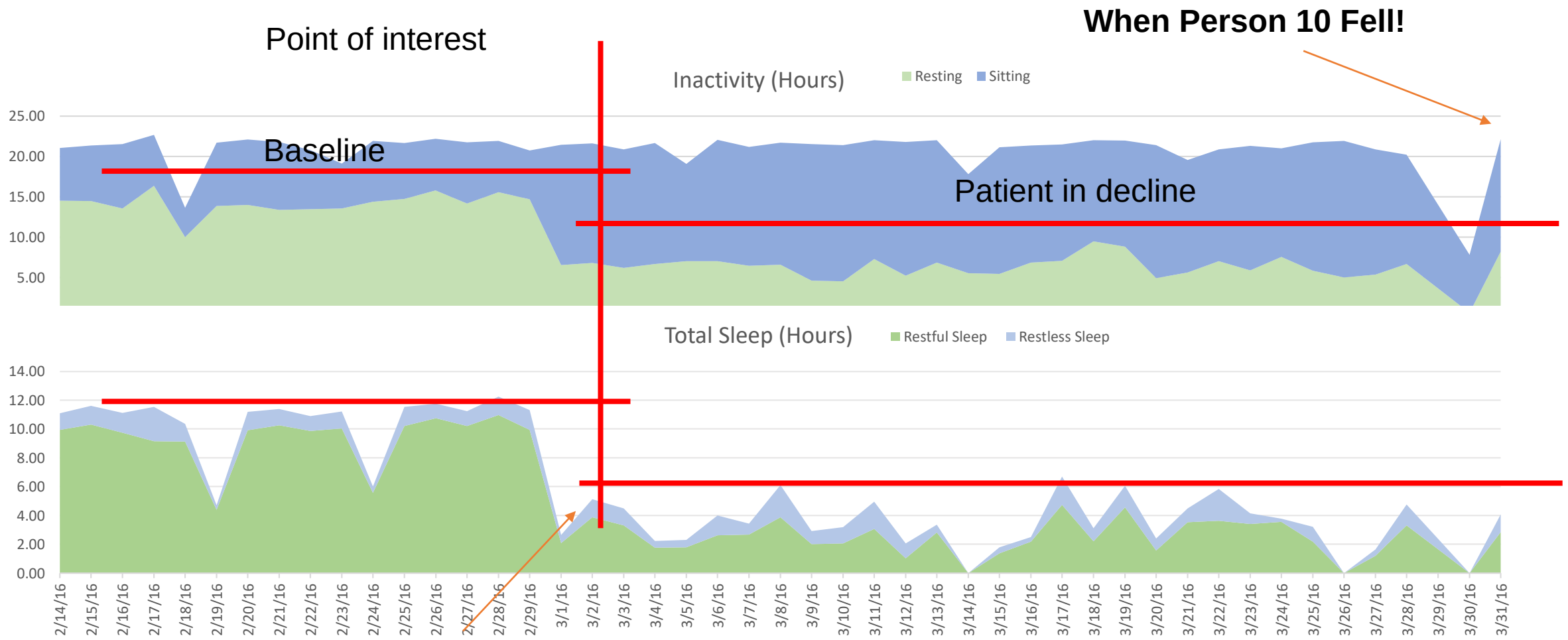

When the ARMED flag would have been raised. 32 days in advance of when person fell

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What’s the Effect of the Environment?

What is the effect of the Environment?

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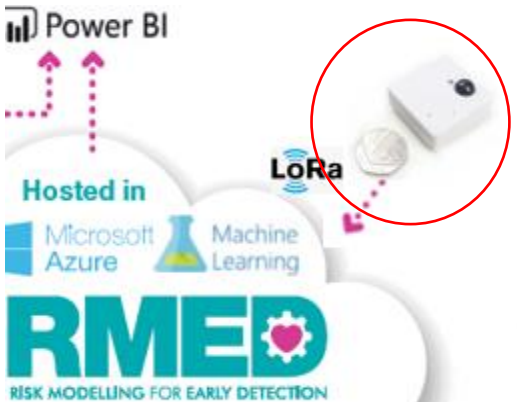
Our LoRa Gateway on the Left attached to a high gain external antenna.

Test Equipment that Boston Network have provided on the right.

- This combined sensor includes
  - Motion Detection(PIR)
  - Temperature
  - Relative Humidity
  - Accelerometer
  - Light detection
  - Magnetic switch

- Data collected over long range low power network called LoRa
- Significantly reduces ongoing monthly costs
- Ability to capture data from very remote & rural locations
- GPS panic button via LoRa



Latest Measure Date
18 February 2019

Latest Update Time
18/02/2019 13:28:37

All Clients Summary (Last 14 days)

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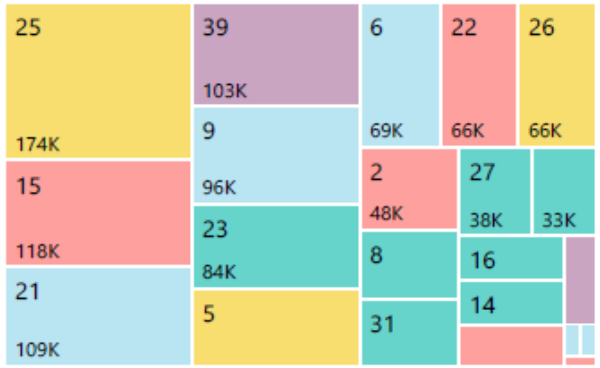
Risk Key
High
Medium
Low
Ok
No Score

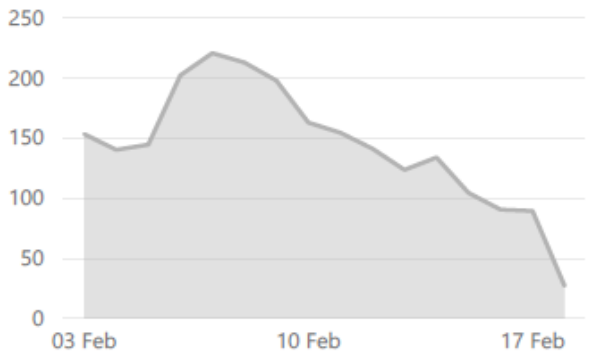
Clients by Risk Level

ServiceUserId	Measure Date	Risk Score	Risk Level
2	16 February 2019	3	High
15	16 February 2019	3	High
26	16 February 2019	2	Medium
9	16 February 2019	1	Low
35	16 February 2019	1	Low
16	16 February 2019	0	Ok
14	16 February 2019	0	Ok
14	15 February 2019	3	High
2	15 February 2019	2	Medium

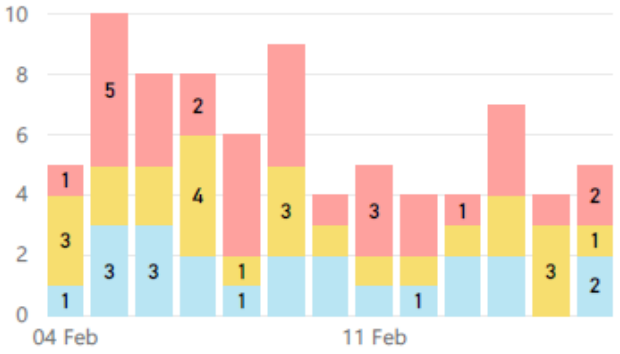
Total Steps by Client



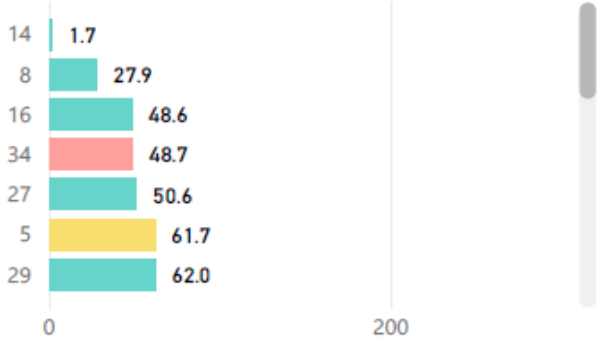
Sedentary Hours by Date



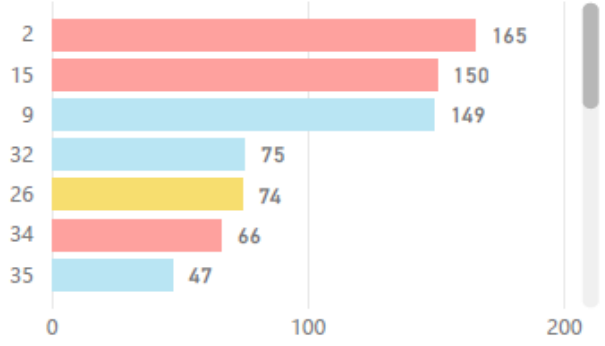
Number of "At Risk" Clients by Date and Risk Level



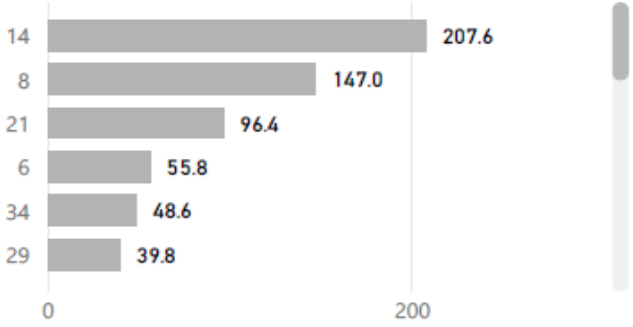
Sleep Hours by Client



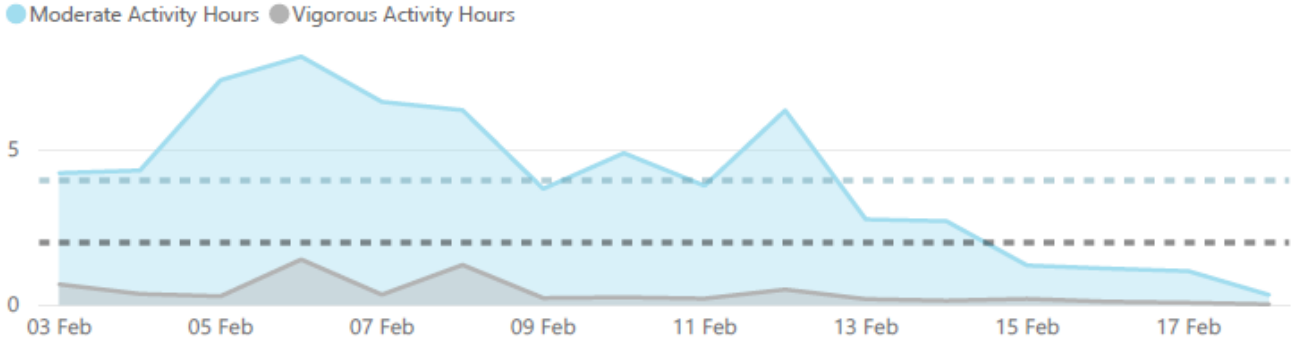
Total Inactive Stamps by Client



Non-Wear Hours by Client



Active Hours by Date



AgencyId
- (Blank)
- 1
- 2
- 3
- 4
- 5

Risk Level
- High
- Medium
- Low
- Ok

Measure Date
- 18 February 2019
- 17 February 2019
- 16 February 2019
- 15 February 2019
- 14 February 2019
- 13 February 2019
- 12 February 2019
- 11 February 2019
- 10 February 2019

ServiceUserId
- 48
- 47
- 46
- 45
- 44
- 43
- 42

Latest Measure Date
13 February 2019

Latest Update Time
13/02/2019 03:19:31

Client Details (Last 14 days)

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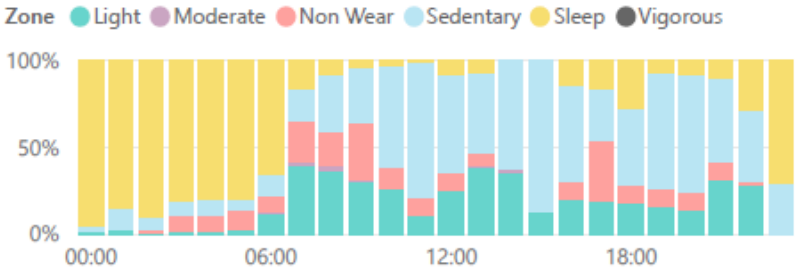
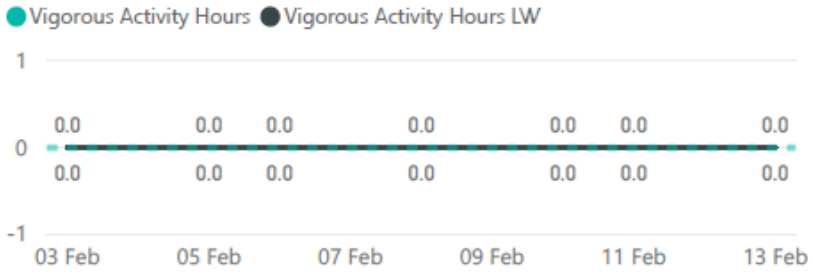
Service User ID
22

Latest Risk Score
3

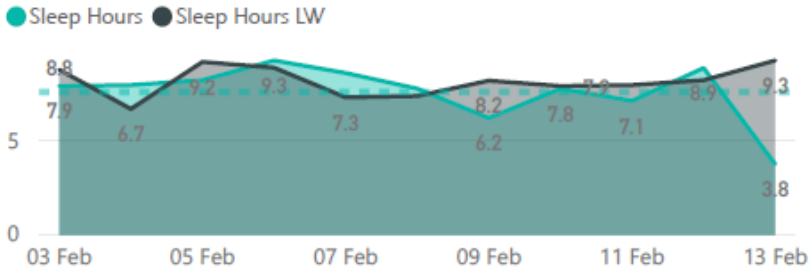
Average Activity by Hour



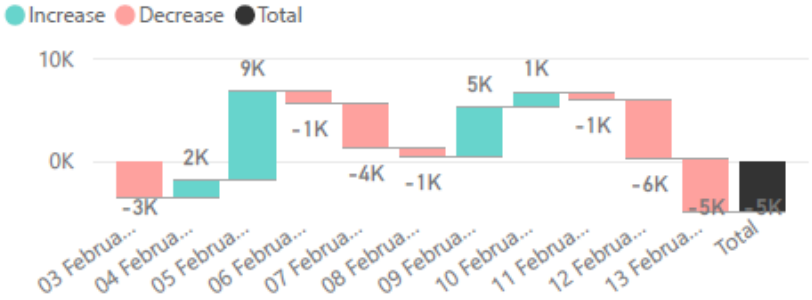
Vigorous Activity Hours vs Last Week by Date



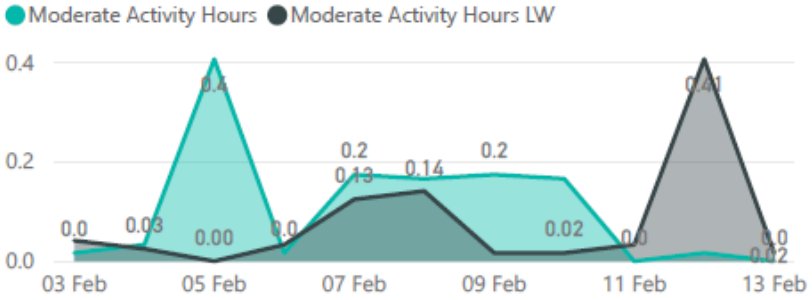
Sleep Hours vs Last Week by Date



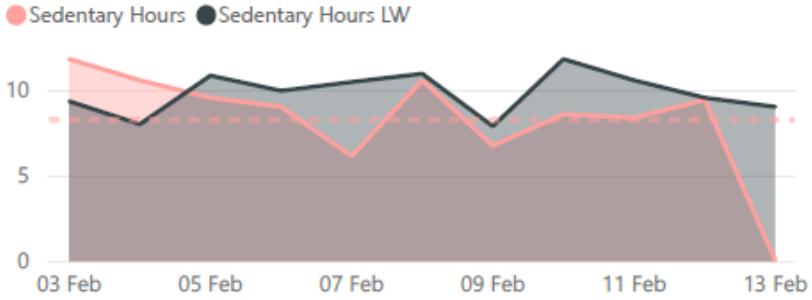
Week on Week Steps Change by Date



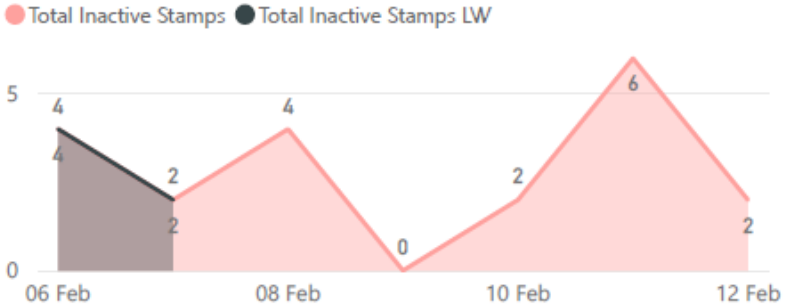
Moderate Activity Hours vs Last Week by Date



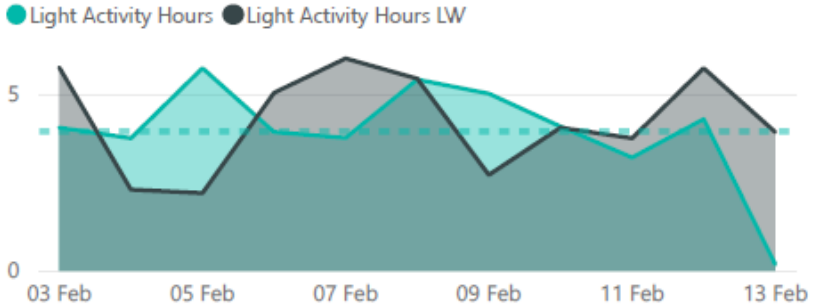
Sedentary Hours vs Last Week by Date



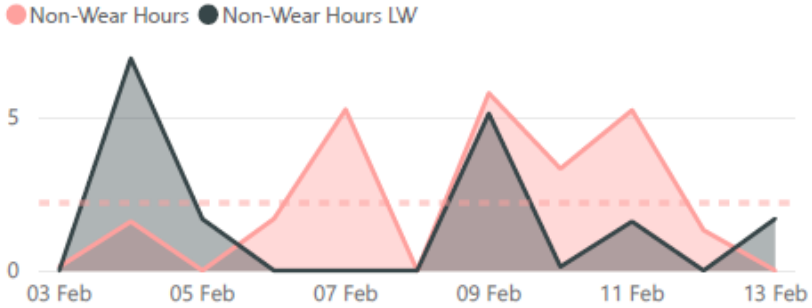
Total Inactive Stamps vs Last Week by Date



Light Activity Hours vs Last Week by Date



Non-Wear Hours vs Last Week by Date



“I have no doubt that, if we get prevention right, it holds the key to longer healthier, happier lives and sustainable, high quality health and care system guaranteed for many generations to come”

Rt Hon Matt Handcock MP, Secretary of State for Health and Social Care

“We must seek a better balance between a system focused on detecting and treating illness, with one that also predicts and prevents poor health”

Duncan Selbie, chief Executive, Public Health England

“If we think about it, falls can lead to fatalities, but even if it’s not a fatality, one of the challenges of an elderly person falling is the healthcare challenge then then ensues. The best way to deal with this is to have preventative care, delivered through sensors and wearable technology that works through machine algorithms”

Satya Nadella, CEO, Microsoft

https://www.cm2000.co.uk/news/microsoft-cm-armed-falls-prevention-technology-digital-outcomes/

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