A new computerised system can continuously measure functional activities of patients in a stroke rehabilitation unit

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1) Introduction and Purpose

To be able to measure patient activity in a continuous and unobtrusive manner we are developing a new automated system based on Real Time Location Technology.[1] This would also allow us to overcome limitations of the current activity monitoring methods.[2]

The system makes use of Radio Frequency Identification (RFID) tags with an in-built motion sensor, room locators and a reader. The tags receive infra-red location signals from a room locator fitted on a wall or ceiling. The tags relay their location and movement signals to a computer every 10 to 20 seconds **(Figure 1)**.

Having established excellent reliability (Intraclass Correlation Coefficients ≥ 0.90), we subsequently validated the system against Observational Behaviour Mapping Technique (OBMT).
We found a high level of agreement between the two methods.[3]
Over 12 hours (720 minutes) a mean difference of 1 minute was found between the methods for measuring the time spent in Own Room (System = 570 mins; OBMT = 569 mins) and the time spent in Physiotherapy Room (System = 49 mins; OBMT = 48 mins).

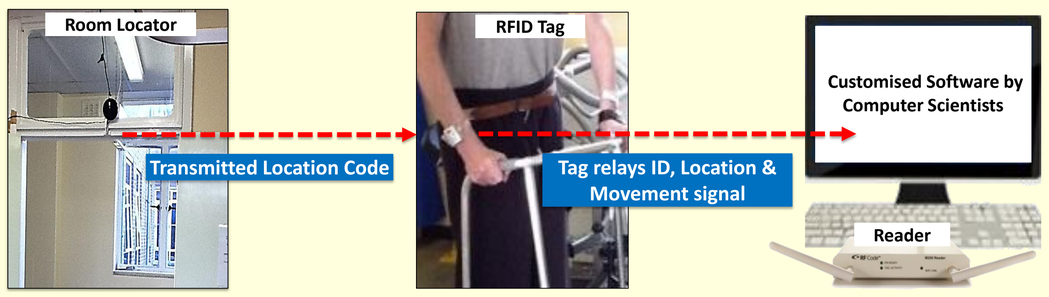
Currently we are measuring functional activities of patients from admission to discharge.

In this study we report the individual activity profiles of 5 patients based on the tag location and movement signals.

2) Methods

The system has been set up in the Regional Stroke Unit, Cardiff. Room locators were fitted in all rooms accessed by the patients. Each participant wore the RFID tag on the unaffected wrist. Through the tag signals, information about where the patients were and when they were moving about was automatically collected for the entire duration of their stay in the stroke unit.

Figure 1: Real Time Location System



Bespoke software programmes were developed for data processing. The amount of time patients spent at a given location and the movement detected at that location was calculated between 7:00 am and 9:00 pm each day. Total time = 14 hours (840 minutes). Descriptive statistics and charts were used for analysis.
Percentages were calculated as:
1.Time spent at each location = total minutes / 840*100
2.Movement detected at each location = total movement / 840*100
3.Time active at each location = movement detected / time spent*100

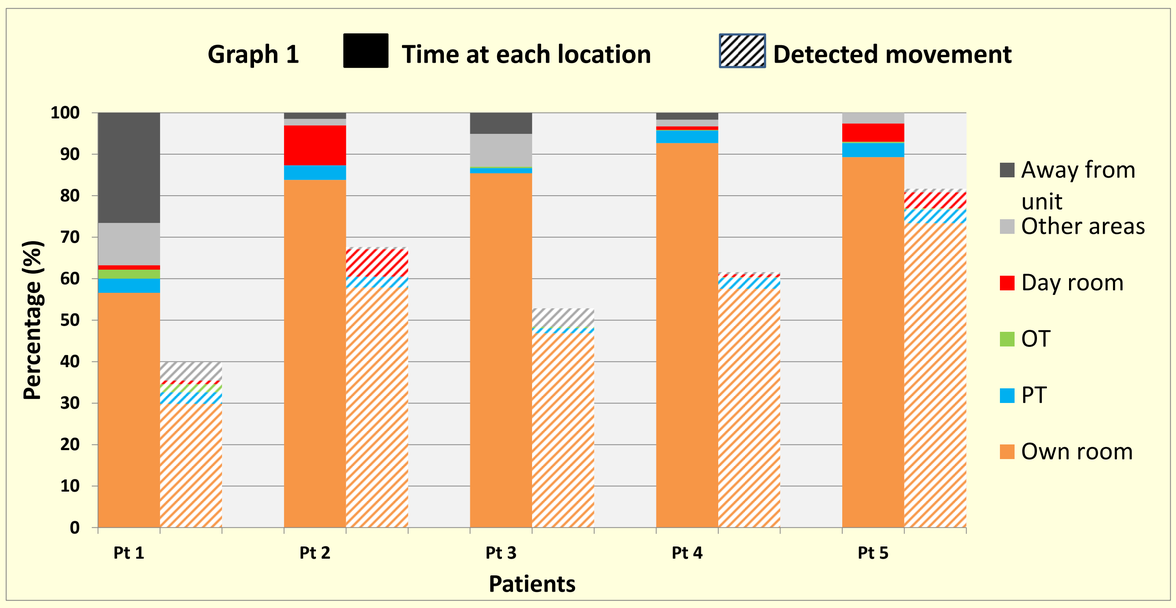
3 (a) Results

Table 1: Demographic details

Patients	Sex	Age in yrs	Type of stroke	Side affected	1st ever stroke	FAC score*	Days post admsn	Follow up days
1	M	58	Lt MCA Infarct	Rt	Yes	3	40	27
2	M	75	Lacunar Infarct	Lt	Yes	4	35	31
3	F	75	Rt Mid Pontine Inf	Lt	Yes	3	3	24
4	F	84	Lt Thalamic Infarct	Rt	No	0	4	58
5	F	88	Pontine Infarct	Lt	Yes	3	3	49

* Functional Ambulation Category

Graph 1 depicts the proportion of time spent and the movement detected in each room for the 5 patients.



The percentage of time spent active in each location is given in **Table 2**. Patients were more active when in Physiotherapy (PT) or in Occupational Therapy (OT) as compared to their own rooms. Overall, Patient 5 was the most active and Patient 1 was the least active.

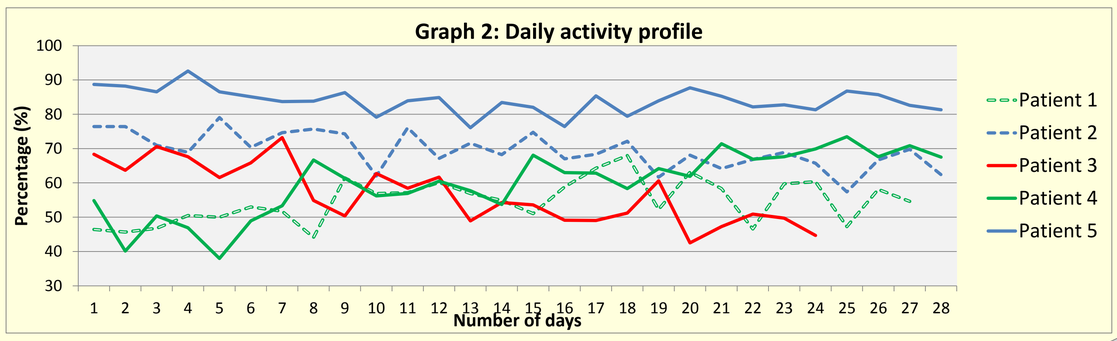
Table 2: Time Active% (Movement detected/ time spent*100)

Patient	Own Room	PT	OT	Day Room	Total time active
1	52 %	82 %	90 %	79 %	54 %
2	69 %	73 %	--	69 %	70 %
3	54 %	97 %	94 %	--	56 %
4	62 %	87 %	92 %	81 %	63 %
5	82 %	96 %	95 %	88 %	83 %

3 (b) Results

The average movement detected in the tag is representative of the quantified daily activity of the patient.

An example of the difference in the activity patterns of these patients over days is seen in **Graph 2**.The activity levels of Patient 2 and Patient 5 remain consistently high. The activity levels of Patient 1 and Patient 4 increase while that of Patient 3 steadily decreases over a 4 week period.



4) Conclusions

- The results indicate that the new automated system is capable of long term patient activity monitoring.
- The next step is to determine the system's ability to measure the time spent undertaking various activities at these locations during the day or a week. For example, the time spent walking outside of therapy hours or on weekends.
- The potential of the system to generate individual patient reports on a daily or weekly basis is being explored further.
- Ultimately, the aim is to generate a better understanding of early rehabilitation post stroke.

References

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