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**Published paper**

Brownsell, S., Bradley, D., Blackburn, S., Cardinaux, F., Hawley, M. (2010) *A review of behavioural monitoring methods and recommendations for future development*, Gerontechnology, 9 (2), p. 201  
<http://www.gerontechnology.info/Journal/main.php?p=12&i=69>

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S. Brownsell, D. Bradley, S. Blackburn, F. Cardinaux, M.S. Hawley. *A review of behavioural monitoring methods and recommendations for future development*. Pressures on healthcare services and the desire to maximise individuals outcomes has led to an increased interest in deploying home-based systems to support people in their own environments. In particular, systems that automatically assess for health care needs or alert users and carers of changing or emergency situations has been an active area of research since the 1990's<sup>1</sup>. Increasingly products exhibiting such behavioural monitoring features are becoming commercially available. However, authoritative evidence of the effectiveness of such systems compared to traditional methods is scarce and deployment seems to be associated with relatively small numbers. To support an ongoing research study to improve behavioural monitoring, a literature review was conducted to determine the technologies and monitoring strategies currently being deployed. A system structure capable of supporting enhanced behavioural monitoring is then proposed.

**Methods** Using pre-defined search terms, a literature review was conducted between January 1990 to December 2008 in the following electronic databases: OvidSP and INSPEC. Thus, covering both health/social and engineering literature. Two investigators independently reviewed the titles and abstracts using set exclusion criteria. Disagreements were resolved by a third investigator. One investigator then obtained the full texts and extracted relevant data using a data extraction sheet established for the purposes of this study. Further, focus groups were conducted with service providers to add clarity on what exactly should be monitored for within a behavioural monitoring system and to define the system structure.

**Results and discussion** Some 1535 papers were identified, of which 76 met the inclusion criteria. Four main results were observed from the analysis: (1) The field is immature, only 16 studies worked with participants and of these 9 were trials. Despite some positive case studies the largest trial involved only 40 people and therefore supportive evidence is sparse. (2) The system objective within the research field is on long-term changes in behaviour, although commercial offerings often focus on short-term health and care assessments. (3) The sensors used are dominated by the passive infra-red (PIR) activity sensors, door contacts and electrical usage sensors. These have numerous limitations which can impact on the quality of the data obtained and the subsequent system performance. (4) Of the 16 studies involving participants, 14 focused on activity as a major element of the monitoring strategy. However, little attention was given to determine what specific activity changes should result in an escalation of monitoring or external alert to a professional (or other named individual).

Three focus groups with 17 service providers added further clarity regarding what behavioural traits should be monitored, which was supplemented by a postal questionnaire to 1,320 participants<sup>2</sup> which had been conducted previously and also sought to add clarity to monitoring strategies. Consequently a prioritised list for a monitoring strategy has been defined along with a behavioural monitoring system structure as outlined in Figure 1. Acknowledgement, this work is funded by the Department of Health and Tunstall Healthcare (HTD grant 313). The views expressed are those of the authors and not necessarily those of the funders.

#### References

1. Celler BG. *et al.* Int Biomed Comput. 1995. 40(2): 147-55
2. Brownsell S, Aldred H, Hawley MS. J Telemed Telecare. 2007. 13: 293-297

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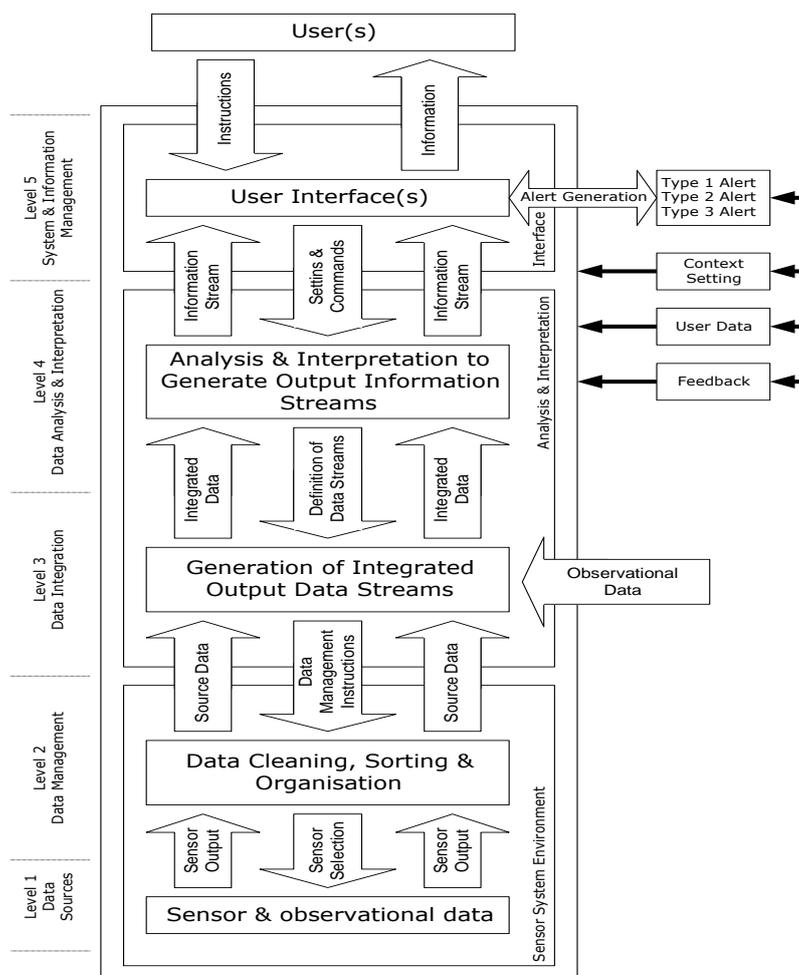


Figure 1: Proposed behavioural monitoring system structure.