Purpose The bed is an integral part of our daily lives. Tele-monitoring of bed-related events provides valuable information of the status of an older adult. Many care systems have been developed based on events detected in bed, for example, detection of bed-exit and fall events[1], recognition of sleep pattern and quality[2], prediction of early signs of illness[3], and monitoring of obstructive sleep apnea syndrome (OSAS)[4]. In such systems, motion sensing in bed, or 'bed actigraphy', is the core technique. This paper presents the development of a commercialized soft motion-sensing mattress, WhizPAD, for unobtrusive sensing of body motion in bed. **Method** WhizPAD is a thin mattress pad made of memory foam and conductive textile materials. Instead of adding sensing components into the bed, WhizPAD is designed into a mattress with motion-sensing capability using the same material and fabrication process of the bedding manufacturer. As a result the mattress is comfortable, flexible in use, easy to install, and low cost. The average resistance of the textile-based piezoresistive sensor decreases monotonically with applied pressure in the range of 1,800-4,300Pa, which is equivalent to pressure caused by the presence of an adult. Given the event algorithms implemented in a bedside data processor, the pressure signals collected by WhizPAD can be used to detect on/off bed, sleep posture, movement counts, and respiration rate. Integrated with information and communication systems, caregivers can maintain awareness of older adults' daily activities and needs by using their mobile devices to access the WhizPAD for real-time monitoring and a historical data record of bed-related activities, as well as receiving service reminders and alerts for abnormal events. **Results & Discussion** With the body-shaped memory foam atop the sensing layer, WhizPAD also helps to decrease the stress applied to the skin. The average body pressure is 17.2% lower when the WhizPAD is put on top of a standard mattress of a nursing bed. In a series of functional tests, sensitivity and positive predictive value (PPV) of recognizing basic bed-related events ranges from 0.79 to 1.00 (*Table 1*). WhizPAD outputs the respiration rate every 20 sec. The average difference in respiration per minute output by WhizPAD is 0.63/min higher than the integer number of complete respiration cycles detected by Polysomnography (PSG). WhizPAD is being sold in department stores and has been implemented in nursing homes in Taiwan. Additional sensors for activity of daily living (ADL) monitoring, such as an infrared sensor for human movements and an electric current sensor for electrical appliance usage, are being integrated with the WhizPAD bedside device, so that the WhizPAD can be extended into a bed-centered telehealth system.

References

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Table 1. Sensitivity and PPV (Positive Predictive Value) of recognizing basic bed-related events

| Functions | On/off bed | Sleep posture | | Movement count |
Types		Lying flat	Lying side	
Sensitivity	1.00	0.79	0.92	1.00
PPV	1.00	0.86	0.84	0.94