

April 3, 2014
The 'Internet of Things' Is Now

Medical Devices & Services

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What inefficiency could IOT address?

In most developed economies, aggregate healthcare costs consume some ~10-18% of GDP, representing a material use of national resources. Within this total, the costs associated with inpatient treatment in hospitals can be meaningful. For example, in the US aggregate cost for hospital stays was US\$375.9bn in 2010, with an average cost per stay of \$9,700. A key driver for reducing costs going forward will be the management of patient length of stay, as well as more “predictive” medicine.

A solid opportunity for the IOT in hospitals

We see two key avenues of opportunity for reduced hospital costs from IOT: patient monitoring; and anonymous data collection.

- Patient monitoring.** In a general ward, patients are typically checked manually by nurses every six to eight hours. The corollary of this is that deterioration in patient conditions may go undetected for hours, leading to re-admittance to intensive care units and longer average stay times. Through digital solutions, key biometrics of patients in general wards may be monitored, freeing up nursing time and allowing faster responses, thereby reducing average stay length and improving patient outcomes.
- Anonymous data.** The collection of anonymous patient data from monitoring devices should also allow for a form of “predictive” medicine. As the dataset on patient outcomes grows, hospitals and doctors will have hard, probabilistic data to determine the likelihood of patients developing certain complications, given their current condition. For example, knowing that a patient has a material probability of myocardial infarction (heart attack) given a certain set of biometrics/conditions, hospital staff may act to supply medication earlier. This anonymous data should be material in driving hospital efficiencies, both through average patient stay, and patient outcomes.

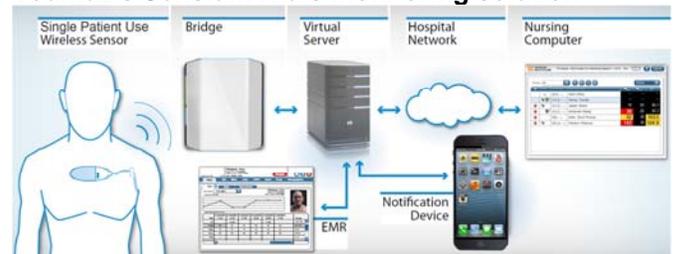
A real world example – Toumaz

Toumaz produces SensiumVitals, a wireless vital signs monitor, which is applied to the skin of patients in a hospital's general ward to allow nurses to monitor vital signs as outlined

above. The device is FDA 510k cleared, and recent trials have shown a six-day decrease in average patient hospital stay days at a savings of \$5,500 per patient, or \$200,000 annually. This compares to an average annual cost of \$20,000, making for an attractive efficiency measure for hospitals. Indeed, we think this cost may be understated, given it excludes the benefit of long-term anonymous patient data collection, as well as the opportunity cost of avoiding expensive acute treatments.

Exhibit 50

Toumaz's SensiumVitals monitoring solution



Source: Toumaz, Morgan Stanley Research

Exhibit 51

Toumaz's monitoring system itself



Source: Toumaz, Morgan Stanley Research

Which incumbent players could be affected?

The advent of patient monitoring / anonymous data collection likely will have a range of impacts on established players:

- Best-positioned** – Obviously well-placed are the hospital operators, who stand to benefit from both a reduced patient cost base, as well as higher patient throughput. Publically listed European companies include: Rhoe Klinikum; Fresenius SE (16% of sales); Generale de Sante; and Synergy Health. Beyond this, we expect IT services and hardware to benefit due to incremental demand from hospitals, while overall public sector

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healthcare costs should also benefit from shorter patient stays and more preventative treatments.

- **Potentially challenged** – Entities that appear to be at risk from this new technology are disparate and harder to discern. Potentially better patient monitoring and more preventative medicine reduces the demand for some consumables associated with acute care procedures, which could act as a headwind at companies such as Getinge and Becton Dickinson. Shorter hospital stays may further be associated with fewer pressure ulcers (bed sores), potentially impacting Smith & Nephew's or Coloplast's Wound Care business (~30% and ~14% of sales, respectively).

Barriers to adoption and timeline

Excluding cost, which we think has already reached an attractive level relative to savings, we see three key barriers to adoption:

1. **Awareness** of the technology among hospital operators needs to be increased over time.
2. **Public opinion** needs to be guided, with patients potentially anxious whether the medical data collection will remain anonymous.
3. **IT systems** at hospitals may need to be improved over time to accommodate the increased data collection on patients.

Despite these issues, we think it reasonable to expect that wireless patient monitoring systems may begin to be implemented within hospitals over the next ~5 years, with most of the benefits from data collection and analysis becoming tangible over the next ~5-10 years.

Working example – implications for US hospitals?

As an illustration, we highlight below the potential cost savings to the US hospital system from the basic introduction of patient digital monitoring. According to the American

Hospital Directory, the country has an average number of patient days per year of ~148.7mn, and we think effective monitoring could conservatively save around 1% of these. Indeed, trials by Toumaz suggested a higher proportion, with average number of days stayed per patient falling by six days. With recent work suggesting an average cost per patient day in these hospitals of around \$917, we think digital monitoring could initially save the US healthcare system almost \$1.4bn in costs. Net of the current costs of Toumaz's SensiumVitals solution, the savings would be in the order of \$1.2bn.

Exhibit 52

Potential US hospital cost savings from digital monitoring

USA patient days per year (mn)	148.7
Saving from monitoring	1%
Days saved (mn)	1.49
Patient cost per day	\$917
Total saving (mn)	\$1,363

Source: American Hospital Directory, Toumaz, Healthcare Cost & Utilization Project, Morgan Stanley Research

Indeed, the savings from monitoring could be larger than this in practice, as the above analysis does not factor in any savings from the increased use of "predictive" medicine, driven by patient data, as well as the opportunity costs of savings from acute procedures that have been avoided. While calculating the impact beyond the basic number of patient days is largely unfeasible due to complexity, we intuitively think the savings to the healthcare system could be substantial.

Conclusion

While only one example of the potential impact from the Internet of Things in the Medical Devices world, we think digital patient monitoring provides a powerful example of potential cost savings and improved patient outcomes. With increased hospital operator awareness and public education, we see potential adoption of the technology over the next 5-10 years.