

Using technology to advance pressure ulcer risk assessment and self-care: Challenges and potential benefits

Technology plays an important role in the identification of biomarkers associated with the early development of pressure ulcers. This article discusses some of the current issues in pressure ulcer assessment and how technological approaches can improve the early identification of pressure ulcers in at-risk people living at home.

ABSTRACT

Pressure ulcers are a debilitating health problem. Assessment of early pressure ulcer damage typically relies on a visual assessment of skin condition and the assignment of scores using paper-based assessment tools. It is difficult to obtain reliable and valid risk scores using these methods. The identification of biomarkers has the potential for a more accurate understanding of cellular level mechanisms. Home use of new technology by at-risk patients and their carers could result in significant reductions in the prevalence of pressure ulcers and the associated morbidities and mortality. We propose that technology has an important role in the identification of biomarkers associated with the early development of pressure ulcers. When used at home by at-risk patients, new technology has the potential to replace the expensive and inefficient current approaches used for diagnosis and treatment of early-stage pressure ulcers. The challenge is to develop newer technology-based systems that patients can use at home to detect their own early-stage ulcers and provide their own self-care. Truly innovative technology could also allow the health care practitioner to have remote oversight of the patient's progress in pressure ulcer prevention. This article discusses some of the current issues in pressure ulcer assessment and how technological approaches can solve some of the factors that impede the early identification of pressure ulcers in at-risk people living at home.

INTRODUCTION

Pressure ulcers (PUs; i.e., bed sores, pressure sores) are localised areas of tissue damage that result from excessive pressure and shearing forces.¹ These wounds range from superficial tissue damage, to severe tissue destruction.² Pressure ulcers occur most often in individuals who have limited activity or mobility and are exposed to prolonged periods of pressure or shear forces, or both.³ Global mortality directly attributable to PUs increased 32.7% from 2000–2010;⁴ PUs also have negative effects on health-related quality of life factors.⁵ The values for prevalence of PUs in acute health care settings in Ireland are consistent with the results obtained by studies performed in other countries (10–38%).⁶ From a community care perspective, PU prevalence is approximately 4% in urban community health care settings.^{7,8} There are also statistically significant increases in prevalence in older age groups; 75% of PUs occur in individuals >60 years of age.⁶ Most PUs can be avoided with effective risk assessment and subsequent targeted interventions,⁹ but approximately 4% of the annual health care budget in Europe is spent on PU-associated care; nursing time accounts for 41% of this cost.¹⁰ Pressure ulcers increase the lengths of hospital stays, and readmission and mortality rates.^{11,12} Despite advances in care and increased funding, PUs remain a significant health care issue.¹³ Severe, foul-smelling infections can develop,¹⁴ and pain is one of the most commonly cited complaints. This pain is



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To be continued:

often intractable and may be exacerbated by some treatments used for wound management.¹⁵

Given the significant human and economic burdens that PUs impose on individuals and societies, it is imperative that focused intervention begins early in at-risk individuals and who preferably have not yet been admitted to an acute hospital setting. Technology focused on biomarker identification is key in helping at-risk individuals, particularly those living at home. Technology can be used to assist with the identification of early damage so that appropriate self-care can begin immediately. Patient involvement in health care and the right of patients to have a central part in the health care process are important components of health care provision.^{17,18} Historically, patient involvement in risk assessment and prevention has tended to be limited across the health care spectrum. Health care professionals have been the sole providers of these functions. However, when patients are more engaged in their own health care, they report an improved experience and increased satisfaction; better clinical outcomes and economic benefits also result.¹⁹ The objectives of more use of primary health care, the desire of individuals to remain in their own homes for as long as possible, and the ever increasing reductions in available trained health professionals combine to make it more important than ever that patients are empowered to take leading roles in their own health care.¹⁷ Consistent with the Europe 2020 Digital agenda, the lives of individuals at risk of developing a PU and living at home can be enhanced by revolutionising the methods used to assess the risk of, and prevent, pressure area development through the early identification of biomarkers. This change can occur through the development of smarter system-based approaches. These technologically innovative approaches will include patients' self-management of their own risk assessment and active participation in prevention of PU development.

Technological challenge

Contemporary PU risk detection mainly involves clinician use of paper-based assessment tools to determine the presence or absence of putative risk factors for PU development.⁹ One recent paper has in essence challenged the validity of this type of assessment indicating that PU formation begins inside the deeper layers of tissue and emerges outwards towards the skin,²⁰ thus highlighting the importance of biomarker identification. External skin assessment will not detect damage until skin changes are apparent. At this point, it is too late to prevent damage to the deeper tissue layers.²¹ The current assessment tools also include risk factors that are not directly associated with PU development.²² This has led to growing criticism of these tools because they distract from the primary

causes of PUs (i.e., immobility, and pressure and shear forces).^{9,23,24} A significant gap in practice has resulted, particularly in primary care. At-risk individuals living at home remain reliant on health care professionals to determine their level of PU risk and subsequent care. Due to the sporadic nature of patient to clinician contact in primary care, a high-risk patient may not be identified in time to prevent tissue damage. More needs to be done to develop and implement simple-to-use technological methods of assessment that allow at-risk patients living at home and their care providers to make decisions that will prevent PU development. Use of this real-time health data will also improve patient self-care and interaction with health care workers.

It is the authors' view that common thought dictates that those most at risk for PU development (i.e., older people with reduced mobility) are typically not adept at use of new technology. However, >63% of older people (57–77 years of age) are willing to use e-Health technology, but in order to optimise use of the technology by the patient, education and time to practice must also be included.²⁵ Any technological innovation would have to empower those at risk via development of a decision support system to enable informed self-management of PU prevention in real-time.

It is clear that technological self-management and its support is critical to the success of using new technology in at risk patients at home. However, self-management is challenging because it includes multiple tasks such as symptom management, adherence to treatment regimes, commitment to appropriate lifestyle changes, and responding to the psychological and physical consequences associated with a condition. Self-management encompasses the ability of the patient to deliver the cognitive, behavioural, and emotional responses necessary to maintain a satisfactory quality of life.²⁶ In relation to early detection of PUs, using technology geared for patient use has the potential to achieve greater success keeping the skin intact, allowing reperfusion, and promoting cell regeneration. The very early PUs with intact skin can be successfully treated²⁷ without requiring the input of a physician. Use of biomarker technology is central to achieving this objective.

Effects of technology

When used by at-risk patients in their homes, technology for risk assessment of PUs may reduce the incidence of formation of severe PUs. This outcome will improve the quality of life of at-risk individuals living at home through the avoidance of the significant morbidity and mortality associated with severe PUs. Patient decision making will be enhanced through increased levels of self-control. Additional potential effects on the individual and on health

services include reduction of direct and indirect costs associated with the management of severe PUs. Finally, because development of a PU in an individual living at home is often a trigger for a hospital or long-term care facility admission, avoiding development of a PU will allow the individual to remain in their own home for a longer period. This outcome results in greater independence and contribution to and longevity within the community setting. Some benefits that can result from the use of technology-based risk assessment are discussed in subsequent sections.

Reduced social and personal indirect costs associated with pressure ulcer prevention

Presence of a PU has negative emotional, physical, psychological, and social effects. After adjustment for age, sex, and co-morbidities, individuals with PUs have lower health-related quality of life scores than those without PUs.²⁸ Pain is one of the most commonly cited complaints by those with PUs.²⁹ In some cases, movement can increase pain so some patients may try to be as still as possible and increase the likelihood of PU development. Greater emphasis on biomarker identification technology will reduce the significant personal and social burdens associated with this health care problem.

Increasing lifespan through pressure ulcer prevention

PUs contribute to increased risk of mortality.³⁰ For example, the presence of a PU exposes an individual to the risk of developing a wide range of complications such as local wound infection, osteomyelitis, cellulitis, septicaemia, and bacteraemia. An older person with a PU has a three times greater risk of death compared with an older person without a PU.³¹ Studies have found odds ratios (ORs) of 4.19 ($p < 0.001$)³² and 3.64 ($p < 0.001$)³³ for death of older patients with a PU in acute care settings. Age increases the risk of mortality in patients with a PU.³⁴ The mortality rate is $< 0.1\%$ in younger hospitalised patients (< 65 years of age) with a principal diagnosis of a PU; in older hospitalised patients, the risk of death increases up to 10% as age increases.³⁵ Research performed in a community setting has found that older people with PUs and living in the community are more likely to die compared with their counterparts without PUs (RR= 1.92, 95% CI 1.52–2.43).³⁶

Pressure ulcer prevention associated with healthy ageing

The association between age and PU development is significant. Demographic forecasts suggest that there will be a three-fold global increase in older persons by 2065.³⁷ Almost 17% of the global population will consist of older individuals, compared with 7% in 2002.³⁷ The skin undergoes some pathological changes as a result of ageing. The elastin and collagen content of the skin changes, reducing its elasticity and resilience. These changes compromise the skin's protective mechanisms against the negative effects of shear and friction.³⁸ Because 72% of all PUs occur in the over 65 years age group,³⁹ a greater focus on providing enhanced early prevention strategies will significantly advance progress in healthy ageing in this population.

Improving PU prevention and care through engagement with advocacy groups

The results of the Eurobarometer Qualitative Study⁴⁰ indicated that patient involvement in their own health care is fundamental to enhancing the quality of the health care received. The benefits of patient involvement include enhanced motivation to adhere to specific treatment regimens because the patient has a greater understanding of the illness. The patient also has a feeling of greater empowerment as they self-monitor their health.⁴⁰ A recurring need for assistance during active engagement in the prevention strategies is associated with PU monitoring and response. Therefore, this concept can be expanded to include the patient's family and carers. The concept of advocacy is closely linked to health literacy, which is the degree to which an individual has the capacity to obtain, communicate, process, and understand basic health information and services to make appropriate health decisions. Health literacy is enhanced when effective patient education strategies are included with the care programme. The concept of patient education has progressed from telling patients what to do to creating conditions for individuals to make informed and empowered health care decisions under the guidance of health care professionals.⁴¹ Any technological advances must include meaningful engagement with advocacy groups that facilitate collaboration between patients and health care professionals and enable a continuous process of learning aimed at addressing specific health and wellness needs in the field of PU prevention. In practice, this col-



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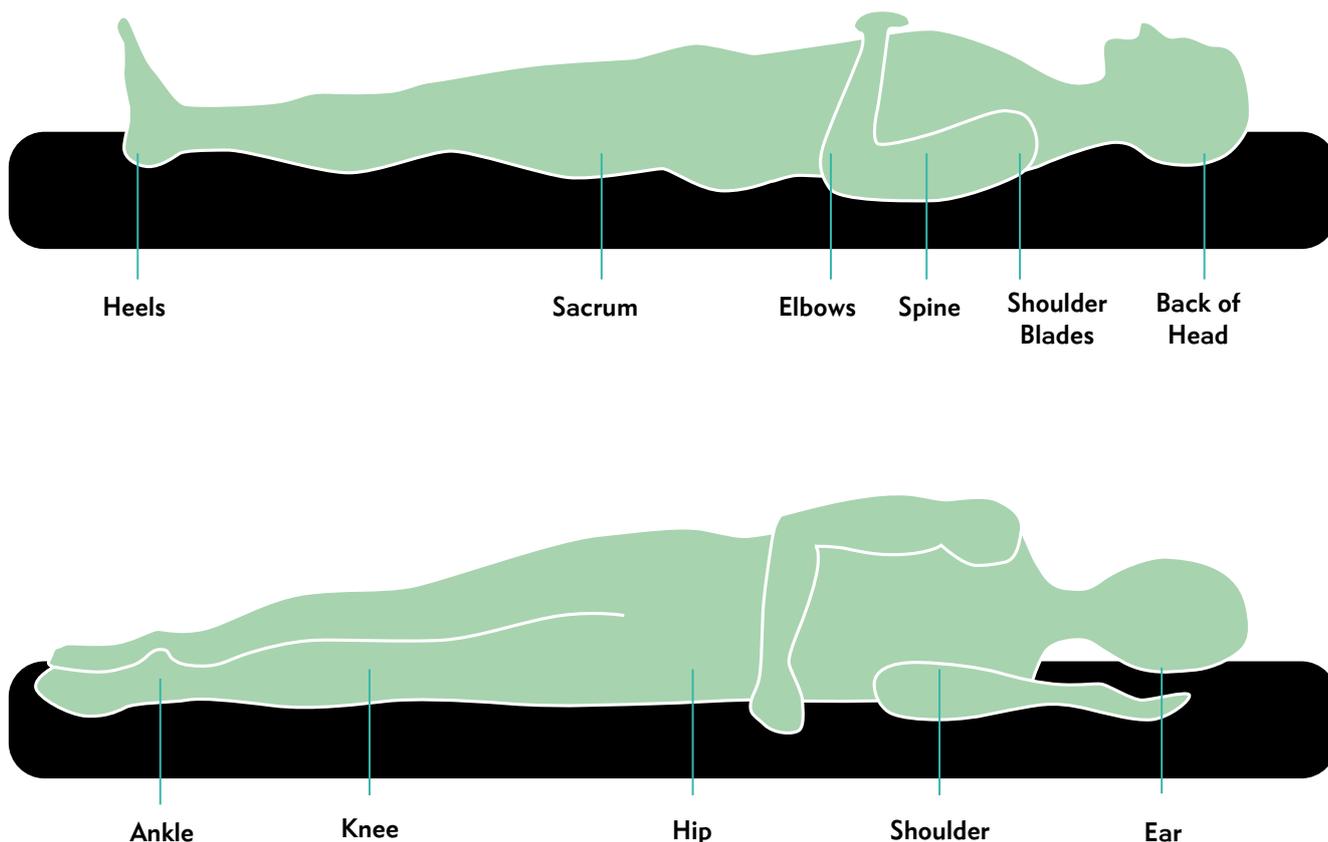
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None



laboration would include combining the new technology with an education package.

Reduced direct costs linked to prevention of pressure ulcers

Due to the cost of treatment and the large number of patients affected, PU management is a significant burden on health care systems. In an economically constrained health care service, revenue spent on PUs can impose a significant burden. However, many PUs can be avoided if best practice early risk assessment is completed with the subsequent use of stage-targeted interventions.⁹ Despite some efforts to use this approach, approximately 4% of the annual health care budget in Europe is spent on PUs; nursing time accounts for 41% of the costs.¹⁰ Pressure ulcer care adds considerable cost to an episode of hospital care.^{12,13,42} But, because most PUs are preventable, greater emphasis on improving prevention strategies will reduce the significant direct costs associated with this health care problem. Use of technologies that enable patients, carers, and clinicians to assess risk could result in significant cost and efficiency savings for services.

CONCLUSION

New technologies for the early identification of PUs present real opportunities for change in terms of better patient outcomes, reduced burdens on families, and reduced fi-

nancial burdens on services. For technologies to work, they must be simple to use for patients, carers, and clinicians. Improved user ability will ensure that the full benefits of a technological advance are realized. Achieving the full effects of any technological advance will also depend on designing in compliance with clinical, digital, medical device, data, and ethics related regulations and standards. Overall compliance with National Information and Communications Technology (ICT) standards and regulations that enable interoperability among systems and devices while providing privacy and security must also be included. The regulatory requirements for new e-health technologies and medical devices change rapidly and often. Therefore, technological advances must be consistent with current and emerging regulatory requirements and guidelines. The success of technology also depends on high levels of participation and satisfaction for users, so it must be simple to use. Overall, PUs present a significant health care problem. The current risk assessment protocols used in primary and community care settings are not optimal. However, technologies that can detect the presence of early stage biomarkers in at-risk people living at home could reduce the effects of current practice limitations. As a result, many at-risk patients will not develop a PU and the associated complications. ■

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