



ORIGINAL RESEARCH PAPER

Management

DESIGN REQUIREMENTS FOR PATIENT BEDS TO PREVENT PRESSURE ULCERS IN IMMOBILIZED PATIENTS UNDER HOME CARE

KEY WORDS: Pressure injury, patient bed, home care, informal caregiver, immobility, patient bed design

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ABSTRACT

Immobile patients cared for at home are vulnerable to pressure injuries because they cannot redistribute body weight and may not be able to communicate, have reduced sensation, tissue fragility, incontinence and chronic illness. Prevention often depends on informal family caregivers who lack training, strength, time and suitable equipment. Hence an ideal patient bed for home care of immobilised patients should incorporate and balance requirements of both- the patient and care giver. Essential requirements include pressure redistribution, assisted repositioning, shear reduction, moisture management, caregiver ergonomics, guidance, safety, affordability and domestic compatibility. These evidence-informed requirements require later technical, usability and clinical evaluation.

INTRODUCTION:

Sustained body weight on the skin, pressurises, deforms and damages it and the deeper tissues causing pressure ulcers. At risk body areas include the sacrum, heels, hips and shoulders. The risk increases when patients cannot communicate, have reduced sensation, tissue fragility, incontinence and chronic illness. Age, malnutrition, co morbidities, diabetes, vascular diseases and incontinence induced moisture/ body heat further reduce the tissue tolerance.

At home the patient is often cared for by some family member who has slipped into this role but is unprepared and untrained for the same. He /she may be aged, physically weak and overburdened but will continue to offer care giving due to unavailability or unaffordability of trained care giving staff. Such care givers hence do not know which assistive technology is needed. They do not have skills or knowledge of caregiving. Most Indian homes do not have any assistive equipment. The patient bed design problem is thus two sided. On one side it must protect the patient's vulnerable pressure points and on the other side, it must help care givers deliver the required preventive procedures.

Objective and Method:

This narrative review synthesises selected literature on pressure-injury factors and pathways, gaps in preventive practices, informal caregiving, and care giving burden. It translates this evidence into requirements for a home-care patient bed. It does not test a prototype or claim clinical effectiveness.

The genesis of and pathways to pressure ulcers:

Immobility concentrates weight over a few skin points, reducing perfusion and increasing tissue deformation. This is best explained by two pathways in the body. Angiogenesis-hypoxia pathway [1] wherein sustained pressure reduces blood flow, causing hypoxia, ischemia and failure of new vessel formation. The second pathway is the Inflammatory pathway [2] wherein ischemia and reperfusion trigger inflammation, swelling and further reduction in oxygen delivery. The third pathway is extracellular matrix pathway [3] wherein pressure and shear damage cells, collagen and elastin, weakening tissue structure. Shear occurs when deeper tissues move while the skin remains fixed, especially when a patient slides down an inclined bed or is dragged during turning. Heat, perspiration and incontinence increase moisture at the skin-surface interface. The fourth pathway is the microclimate pathway [4] wherein heat and moisture weaken the skin barrier and increase susceptibility to friction, shear and pressure injury. A patient bed design should address these causes.

Lack of preventive procedure knowledge and skills leading to pressure injuries

Prevention depends on implementation as well as knowledge. Nuru et al. (2015) [5] found that only about half of the nurses studied demonstrated good knowledge and preventive practice; training, staffing and equipment influenced performance. Gunningberg et al. (2001) [6] found gaps between knowledge, documentation and guideline compliance. Beeckman et al. (2011) [7] found fully adequate prevention in only 13.9% of at-risk patients, despite studying trained hospital personnel.

The challenge is greater for informal caregivers. Sharma et al. (2013) [8] found limited training and inconsistent home bedsores-prevention practices in India. Benner's (1984) [9] novice-to-expert model indicates that competence develops through education and experience. Bed design should therefore reduce dependence on memory, strength, experience and specialised skill.

Care giver burden as a cause

A poorly designed bed transfers the physically demanding preventive and curative tasks of lifting, turning, cleaning, observation and documentation work to the family Ramos et al. (2022) [10] reported substantial burden among caregivers of people with pressure ulcers. Huang et al. (2019) [11] linked chronic-wound caregiving burden with patient dependence, long care hours and low caregiver self-efficacy.

Design requirements of an ideal patient bed for home care of immobilised patients:

Pressure redistribution

The surface should spread load and protect the sacrum, heels, hips and shoulders. Zoned high-specification foam or a suitable air-foam system may provide immersion while preserving posture.

Assisted repositioning

The bed should support small position changes through an inbuilt sequential, simple lateral-tilt or turn-assist mechanism. Patient movement should be slow and should be easy to operate by the care giver. It should be physically non-demanding for the care giver.

Shear and friction control

Low-friction layers and positioning aids to stabilise the body without acting as restraints or creating new pressure areas be designed. High support can reduce sliding.

Moisture and microclimate management

Exposed components should be washable, quick-drying and separately replaceable. Inbuilt urine and faeces collectors for reducing wetness due to incontinence be present. Heat and moisture sensors announcing the need for care giver intervention be built.

Caregiver ergonomics

The frame should reduce bending, reaching and lifting by the care giver. The bed should be built as per Indian anthropometric measurements.

Guidance and documentation

The bed should also act as a cognitive aid. Position indicators, a turning-time marker, moisture and heat sensors announcing the need for care giver preventive care giving can reduce the care giver burden.

Safety and domestic fit

The bed should minimise falls, sharp edges and have side rails. Since it will be used inside the homes all over India, the bed frame should pass through residence doors, work in small rooms and be maintainable, cleanable, disinfect able and run on battery. Sensors for heat and moisture should be low cost, replaceable and optional.

DISCUSSION:

The argument is sequential. Immobility and tissue vulnerability create biological risk. Home care transfers prevention to family caregivers. Limited competence, burden and unsuitable equipment weaken implementation. The bed should therefore convert preventive principles into easier physical actions.

The paper links the biomechanical forces, cellular and physiological cascades, caregiver needs, ergonomics, preventive care routines and bed maintenance together into patient bed features for home care of immobilised patients prone to pressure ulcers.

Other intrinsic pressure injury causative factors such as malnutrition, co morbidities and diabetes, poor nutrition, age, arterial pressure cannot be addressed by this. Such a patient bed cannot replace assessment, professional advice and caregiver education. Its role is to reduce harmful conditions and make recommended care more achievable.

Future development should evaluate micro environment, ergonomics, bio mechanics and affordability before clinical claims are made.

CONCLUSION:

An ideal patient bed for home care of immobilised patients should incorporate as a single system, the requirements of both- the patient and care giver as well as the upkeep and disinfection need of the bed and the affordability perspective.

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