Department of Mechanical Engineering

Mechanical Engineering Design

ENME 301 Assignment 1: Concept Design

Coversheet for online submission

AUTHORSHIP	
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DECLARATION (MUST BE SIGNED):
I (we, if group work) have read and fully understood the Department's Statement Regarding Dishonest Practice (on the back) and hereby certify that this item of work submitted for assessment is entirely my/our own work.
Signed: 
Date: 02.03.2021

GUIDELINES FOR ONLINE SUBMISSION
• Scan this cover sheet, the sketch and report, into a single pdf. Make sure it is all visible. • Resolution preferably about 300 dpi • Please make the pdf file name of the form: lastnamestudentnumber.pdf • Submit through the online submission portal called "Assignment 1: Concept Design Submission" on LEARN in the Assignment 1 section.

Department's Statement Regarding Dishonest Practice

(in connection with work submitted for assessment)

The University's interpretation of what constitutes dishonest practice includes the following:

1. **Plagiarism**, being the presentation of any material (text, data or figures, on any medium including computer files) from any other source without clear and proper acknowledgement of the source of that material.

2. **Collusion***, being work performed in whole or in part in conjunction with another person or persons, but submitted as if it had been completed by the named author alone (or joint authors if a group item of work).

3. **Copying**, being the use of material (in any medium, including computer files) produced by another person or persons, with or without their knowledge and approval.

4. **Ghost writing**, being the use of another party (with or without any form of payment) to prepare all or part of an item of work submitted for assessment. Under the University Regulations, evidence of any of these or other forms of dishonest practice by any student(s) represents grounds for disciplinary action and may result in penalties ranging from denial of credit for the item of work in question to exclusion from the University.

* This interpretation of the dishonest practice of collusion is not intended to discourage students from having discussions with each other about how to approach a particular assigned task, and incorporating general ideas coming out of such discussions into their own individual submissions.

// ENME301 ASSIGNMENT 1 – Jackson Crawford 79117073

Description, features and benefits:

The proposed concept is for a system to allow a single elderly carer to use existing Hoyer lift and sling systems to facilitate the movement of an elderly patient from lying down to a seated position. The concept consists of a pair of pneumatic bladders that are installed onto the patient's bed, similar to a bedsheet. Inflating and deflating these air bladders through the use of a compressor and electrically actuated valves allows an elderly carer to roll over the patient and place the sling underneath them, to then be attached to the lift. This process normally would require at least two carers, one to roll the patient and another to place the sling. With an assisted Hoyer lift, this design would allow a single carer to care for the patient in their own home.

This approach has several benefits:

- Existing sling and harness systems can be used with no compatibility issues.
- The approach is mechanically simple and low-cost.
- Operable by a single carer. This carer could be the patient's partner, as the apparatus does not require any meaningful physical strength to operate.
- Simple to install.
- Compliant nature of the airbag greatly reduces risk of injury to a frail elderly patient.
- The airbag can easily be removed from the bed and machine washed, with one connection between the airbag and the pneumatic controls.

Possible risks or problems:

- The apparatus requires a compressor to provide air, which may be loud.
- There is a risk of the apparatus being punctured and deflating.
- May require the patient's bed to be re-made between uses.
- A guard rail may be required to ensure patients are not rolled off the bed.
- The process would be slower than with two carers.

Closest existing concept:

Airbag systems exist for use with cars to get them out of sand, mud, etc, though the proposed concept differs in complexity and purpose, if not basic principle. Alternating pressure air mattresses (APAM) exist for reducing pressure sores in patients that are bedridden for extended periods, which is a similar concept in a similar field, though the application differs greatly.

Selling price estimate:

Item	Justification	Price
Airbag	High-end commercially available air-beds retail around this price. Lower production volume and novel geometry increasing price are likely offset by much less material required.	$150
Compressor	Large budget is dedicated to the compressor unit, as high-performance to increase speed of operation while maintaining low noise is important.	$800
Pneumatic Fittings	Pneumatic hardware is ruinously expensive. It is unknown to what degree commercial quantities would lower prices.	$700
Controller unit, HMI	Microcontroller, electronics, housing, etc.	$150
		Total: $1800

The average cost of full time resthome care in New Zealand is currently $1119 weekly, so a retail price in the range of $2500-3500 seems reasonable, to account for design work, profit, and unforeseen costs.

References:

https://www.ncbi.nlm.nih.gov/books/NBK76153/ - APAM study.

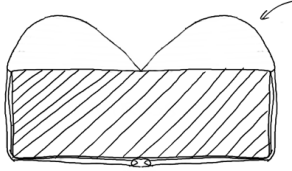
https://www.arjo.com/int/products/pressure-injury-prevention---pip/alternating-pressure/alpha-active-3/ - retail APAM.

https://lcpshop.net/product/air-jack-inflatable-bag-car-lifter/?gclid=Cj0KCQiAvvKBBhCXARIsACTePW99EWVlJ8klvg4o8tXwB3AVkcuOgNNy7wLygZFRENgZU3upHPZy97UaAkvqEALw_wcB – airbag car jack.

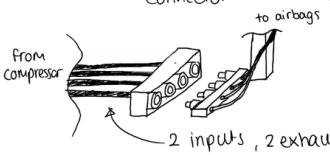
https://gazette.govt.nz/notice/id/2020-go2874 - resthome pricing, see appendix A

Jackson Crawford 79117073 GNM6301 Design Project

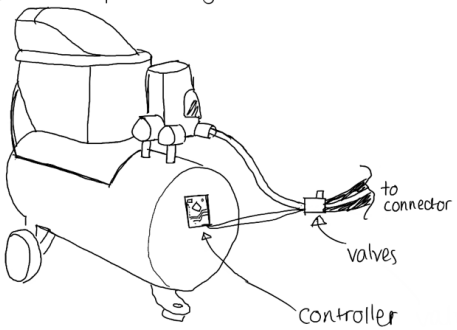
7. Cross-section view (airbags inflated)



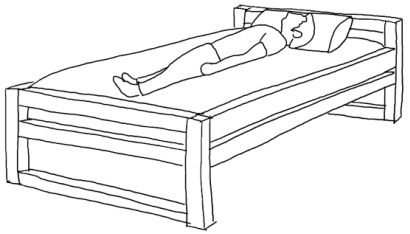
8a. quick-release connector



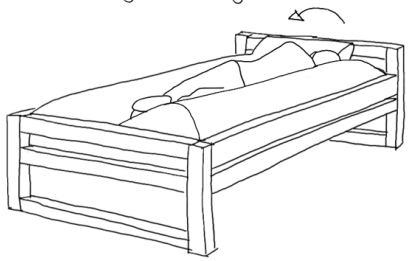
8b. Compressor System



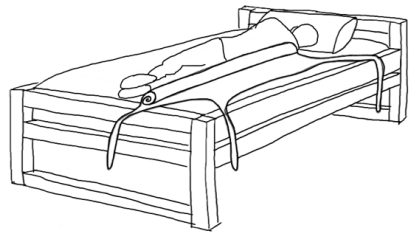
1. Patient in supine position on bed, expresses the wish to move to a seated position



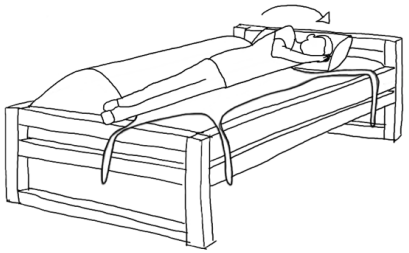
2. Patient is rolled over using right airbag.



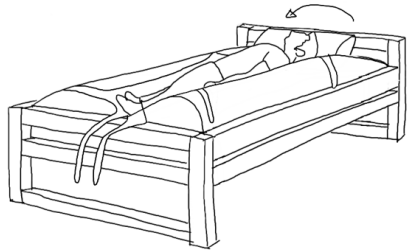
3. Right airbag deflated, sling placed behind patient



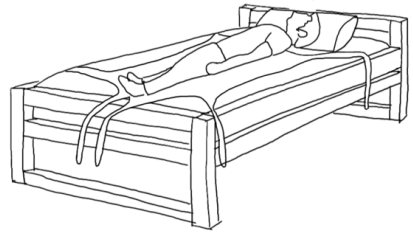
4. Left airbag inflated to roll patient



5. Left airbag is deflated and sling rolled out. Patient is then returned to supine position using right airbag



6. With right airbag deflated, patient is ready to be lifted to seating position with hoist and sling



APPENDIX A- Resthome Care Pricing

DHB	REGION	WEEKLY PRICE
Far North District	Northland	$1,100.75
Whangarei District	Northland	$1,126.93
Kaipara District	Northland	$1,100.75
Rodney District	Waitemata	$1,156.40
North Shore City	Waitemata	$1,188.81
Waitakere City	Waitemata	$1,162.98
Auckland City	Auckland	$1,193.08
Manukau City	Counties Manukau	$1,180.20
Papakura District	Counties Manukau	$1,156.40
Franklin District	Counties Manukau	$1,123.64
Thames-Coromandel District	Waikato	$1,105.37
Hauraki District	Waikato	$1,105.37
Waikato District	Waikato	$1,105.37
Matamata-Piako District	Waikato	$1,105.37
Hamilton City	Waikato	$1,135.75
Waipa District	Waikato	$1,105.37
Otorohanga District	Waikato	$1,096.48
South Waikato District	Waikato	$1,096.48
Waitomo District	Waikato	$1,100.82
Taupo District	Lakes	$1,126.93
Western Bay of Plenty District	Bay of Plenty	$1,123.64
Tauranga City	Bay of Plenty	$1,141.91
Rotorua District	Lakes	$1,126.93
Whakatane District	Bay of Plenty	$1,118.25
Kawerau District	Bay of Plenty	$1,100.75
Opotiki District	Bay of Plenty	$1,100.75
Gisborne District	Tairawhiti	$1,103.13
Wairoa District	Hawke's Bay	$1,122.45
Hastings District	Hawke's Bay	$1,122.45
Napier City	Hawke's Bay	$1,122.45
Central Hawke's Bay District	Hawke's Bay	$1,122.45
New Plymouth District	Taranaki	$1,122.45
Stratford District	Taranaki	$1,100.75
South Taranaki District	Taranaki	$1,105.37
Ruapehu District	Waikato	$1,100.82
Wanganui District	Whanganui	$1,105.37
Rangitikei District	Whanganui	$1,100.75
Manawatu District	MidCentral	$1,100.75
Palmerston North City	MidCentral	$1,118.25
Tararua District	MidCentral	$1,100.75
Horowhenua District	MidCentral	$1,100.75
Kapiti Coast District	MidCentral and Capital & Coas	$1,126.93
Porirua City	Capital & Coast	$1,126.93
Upper Hutt City	Hutt Valley	$1,118.25
Lower Hutt City	Hutt Valley	$1,143.87
Wellington City	Capital & Coast	$1,163.33
Masterton District	Wairarapa	$1,103.13
Carterton District	Wairarapa	$1,100.75
South Wairarapa District	Wairarapa	$1,100.75
Tasman District	Nelson Marlborough	$1,148.56

Nelson City	Nelson Marlborough	$1,148.56
Marlborough District	Nelson Marlborough	$1,118.25
Kaikoura District	Canterbury	$1,123.64
Buller District	West Coast	$1,096.48
Grey District	West Coast	$1,096.48
Westland District	West Coast	$1,096.48
Hurunui District	Canterbury	$1,105.37
Waimakariri District	Canterbury	$1,123.64
Christchurch City	Canterbury	$1,131.13
Banks Peninsula District	Canterbury	$1,131.13
Selwyn District	Canterbury	$1,123.64
Ashburton District	Canterbury	$1,109.57
Timaru District	South Canterbury	$1,105.37
Waimate District	South Canterbury	$1,096.48
Waitaki District	Southern	$1,096.48
Central Otago District	Southern	$1,100.75
Queenstown-Lakes District	Southern	$1,144.43
Dunedin City	Southern	$1,118.25
Clutha District	Southern	$1,096.48
Southland District	Southern	$1,096.48
Gore District	Southern	$1,096.48
Invercargill City	Southern	$1,100.75
	TOTAL:	**$1,118.38**