

Exploring variation in length of hospital stay among an elderly cohort of acute surgical admissions

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Abstract

Aim

Increased length of stay (LOS) indicates complex health care needs. It is unclear if age alone can be used as an indicator of longer hospital stays.

Methods

Retrospective review of acute surgical admissions (2016-2018) was performed, dividing data into three age groups (Group 1 (ages 65–74), Group 2 (ages 75–84) and Group 3 (aged 85 and above). Effect of the independent variables; age, Groups of Episodes with similar diagnosis (GESD) and surgical interventions was noted on the LOS as well as discharge disposition and mortality. Subset analysis was performed for admissions with above average LOS.

Results

1880 (27.7%) patients (total admissions=6793) were analysed. Mean LOS in each age group was 12.5, 13.3 and 12.5 days respectively ($p=0.68$). There was a mean 13 day increase with acute surgical intervention under General Anaesthesia, in comparison to 7.3 days and 5 days for Interventional Radiology and emergency endoscopy. 1496 (79.6%) patients were discharged home. 118 (66.0%) patients transferred to convalescent centres were over 75 years.

Among those with above average LOS no significant correlation was found between sex, diagnosis, interventions with longer LOS.

Discussion

In acute settings, variables other than age are important to understand the variation in LOS. LOS is significantly influenced by diagnosis and acute intervention. Once patients exceed average LOS, resources should be explored to facilitate discharge planning.

Introduction

Developed societies are undergoing significant demographic shifts with aging of its population. National census (2016) shows the number of persons aged 65 and over is projected to increase in excess of 65% across all regions of Ireland by 2036¹. This development is global². Emergency surgery, a high-volume and diagnostically diverse specialty, is experiencing rising numbers of elderly admissions, particularly in Europe³⁻⁵. In the UK most National Health Service hospital bed occupants are older patients because of their frequent admissions and prolonged length of stay (LOS)⁶. This has a major impact on the health system in terms of acute health care services.

Numerous variables affect the LOS following acute admissions⁷ but lack of clarity regarding which factors influence the length of hospitalisation itself⁸. A general assumption is that age affects the LOS^{5,9}, and elderly are at a risk of longer duration of stay, post-operative complications and admissions to the ICU⁹. Understanding such influences is becoming increasingly important as surgical care becomes more outcomes focused¹⁰.

The validity of age alone as a reliable predictor of LOS is unclear. Although some high-quality studies exist in related fields, the overall evidence base informing perioperative acute care for the elderly remains limited¹¹, existing literature examines the safety and outcomes of elective surgery.

We explore a subset of elderly patients who have extended hospital stays in an attempt to identify variables, apart from age, leading to a vulnerability for adverse health outcomes in terms of mortality and the rehabilitation services required.

The objective of this study is to determine whether increased age is a reliable predictor of LOS in the elderly, in acute clinical settings. Secondary analysis to identify the subset of patients who are more likely to have extended in-hospital stays and define characteristics, demographics and independent variables for these admissions.

Methods

Study design is retrospective, cross-sectional, observational study.

The study is based in a university hospital. It is a 562 bed, 12 theatre, 14 Critical Care bed hospital. The hospital has a catchment population exceeding 500,000.

Primary Outcome is LOS following acute surgical admission in advanced age-groups.

Secondary outcomes are discharge disposition and mortality.

Along with age, other variables affecting LOS under observation in this study are the diagnosis at presentation and acute surgical procedure carried out.

All adult acute admissions 65 years and above presenting to general and vascular surgery between 1st January 2016 and 31st December 2018 were included. Elective, orthopaedic admissions and trauma were excluded.

Ethics for this study was sought and approved from the Research Ethics Committee, Tallaght University Hospital. REC: 2019-07.

A retrospective study was carried out from Hospital In-Patient Enquiry (HIPE) system database using nonprobability consecutive sampling.

The sample was divided into three age groups: Group 1 (65–74 years), Group 2 (ages 75–84) and Group 3 (85 years and above), devised into 10-year intervals in accordance with the NQAIS (National Quality Assurance Information System) guidelines, for easier replication of comparative metrics at other sites. Diagnosis related groups are defined and the data is presented with emphasis on emergency surgical procedures carried out, length of in hospital stay, discharge disposition and mortality rates.

The data set was analysed using Excel for its database function and the secure SPSS statistical software TM (California/USA). Data was stratified in terms of age, gender and emergency surgical procedures carried out; categorised as No procedure, procedure under General Anaesthesia, Emergency endoscopy, or Interventional Radiology, to see the effect of these on the outcomes (length of stay, discharge destination and mortality rates), followed by comparison between the subgroups according to age. Logistic regression analysis and univariate linear analysis was performed for descriptive variables and how they affect LOS. A separate sub-set of the sample was identified having an extended LOS above the sample's average length of stay (AveLOS) and their characteristics analysed.

Results

A total of 6793 acute surgical admissions were recorded over the study duration, of which 1880 (27.7%) unique patients met the inclusion criteria.

Demographic Profile

The sample had a mean age of 75.1 ± 0.17 years with a female to male ratio of 1:1.25. Mean age of the sub-groups Group 1, 2 and 3 is 69.25, 79.12 years and 88.18 years respectively. The average LOS of the study population was 12.81 ± 0.54 days. The average length of stay in group 1, group 2 and group 3 was 12.5 days, 13.3 days and 12.5 days respectively (table 1). Age does not show a statistically significant difference for LOS in acute surgical settings in the elderly population ($p=0.68$).

Variables and Outcomes	Age Groups			Total
	65 to 74 Years	75 to 84 Years	85 Years & Above	
Mean Age \pm SD	69.2 \pm 2.8	79.1 \pm 2.8	88.2 \pm 3.146	75.1 \pm 7.3
Ave LOS (Days) \pm SD	12.5 \pm 25.90	13.3 \pm 21.7	12.5 \pm 16.8	12.8 \pm 23.5
Discharge Disposition				
Home	830 (44.2%)	524 (27.9%)	142 (7.5%)	1496 (79.6%)
Nursing/Convalescent Home	61 (3.2%)	66 (3.5%)	52 (2.8%)	179 (9.5%)
Self-Discharge	8 (0.4%)	2 (0.1%)	2 (0.11%)	12 (0.6%)
Emergency Transfer to Acute Hospital	29 (1.5%)	29 (1.5%)	12 (0.6%)	70 (3.7%)
Non-Emergency Transfer to Acute Hospital	24 (1.3%)	18 (0.9%)	8 (0.4%)	50 (2.7%)
Died Post-Mortem Carried Out	2 (0.1%)	0 (0%)	1 (0.05%)	3 (0.16%)
Died No Post-Mortem Carried Out	24 (1.3%)	28 (1.5%)	16 (0.8%)	68 (3.62%)
Hospice Care	0 (0%)	1 (0.05%)	0 (0%)	1 (0.05%)
Prison	1 (0.05%)	0 (0%)	0 (0%)	1 (0.05%)
Total	979 (52.1%)	668 (35.5%)	233 (12.4%)	1880 (100%)

Table 1. Age statistics and its relationship to discharge disposition and mortality

Surgical Intervention

Of all the admissions 973 patient (51.7%) underwent a surgical intervention, categorised as procedure under General Anaesthesia (n= 499, 26.5 %), Emergency endoscopy (n=393, 20.9 %) or Interventional Radiology (n=81, 4.3 %).

Length of stay is significantly influenced by an acute surgical intervention when analysed opposed to not having to undergo a surgical intervention (P<0.001). The mean LOS of the sample increased by 13 days for patients who underwent any procedure as opposed to those who did not have any acute intervention. Subgroup analysis performed regardless of age stratification showed a maximum increase in LOS in the patients who underwent a procedure

under G/A with an AveLOS of 21.2 days (95% CI: 18.0 – 24.3), followed by IR with an AveLOS 15.3 days (95% CI: 11.3 – 19.3, increase of 7.3 days from patients with no intervention performed) and Endoscopy with an AveLOS 12.9 days (95% CI: 10.8 – 15.0, increase of 5 days from patients with no intervention performed). The statistically significant influence is confirmed by Univariate linear regression analysis of each type of acute surgical intervention carried out on the LOS ($p < 0.001$).

Comparison of interventions among age groups

Multivariate analysis of age subgroups based on the acute interventions performed confirmed a similar increase in LOS within each age group with no significant difference amongst age groups ($p = 0.72$) Table 2. In Group 3, 57 (49%) patients undergoing a procedure had an above average extended LOS, while 25 patient (21%) without an acute intervention had an extended LOS.

See figure 1.

Intervention Performed	Age Groups	LOS 1 to 10 days	LOS More than 10 days
NO	65 to 74 years	399 (85.40%)	68 (14.60%)
	75 to 84 years	266 (82.10%)	58 (17.90%)
	85 and above	93 (78.80%)	25 (21.20%)
YES	65 to 74 years	283 (55.30%)	229 (44.70%)
	75 to 84 years	187 (54.40%)	157 (45.60%)
	85 and above	58 (50.40%)	57 (49.60%)

Table 2: Relationship of length of stay with acute surgical intervention

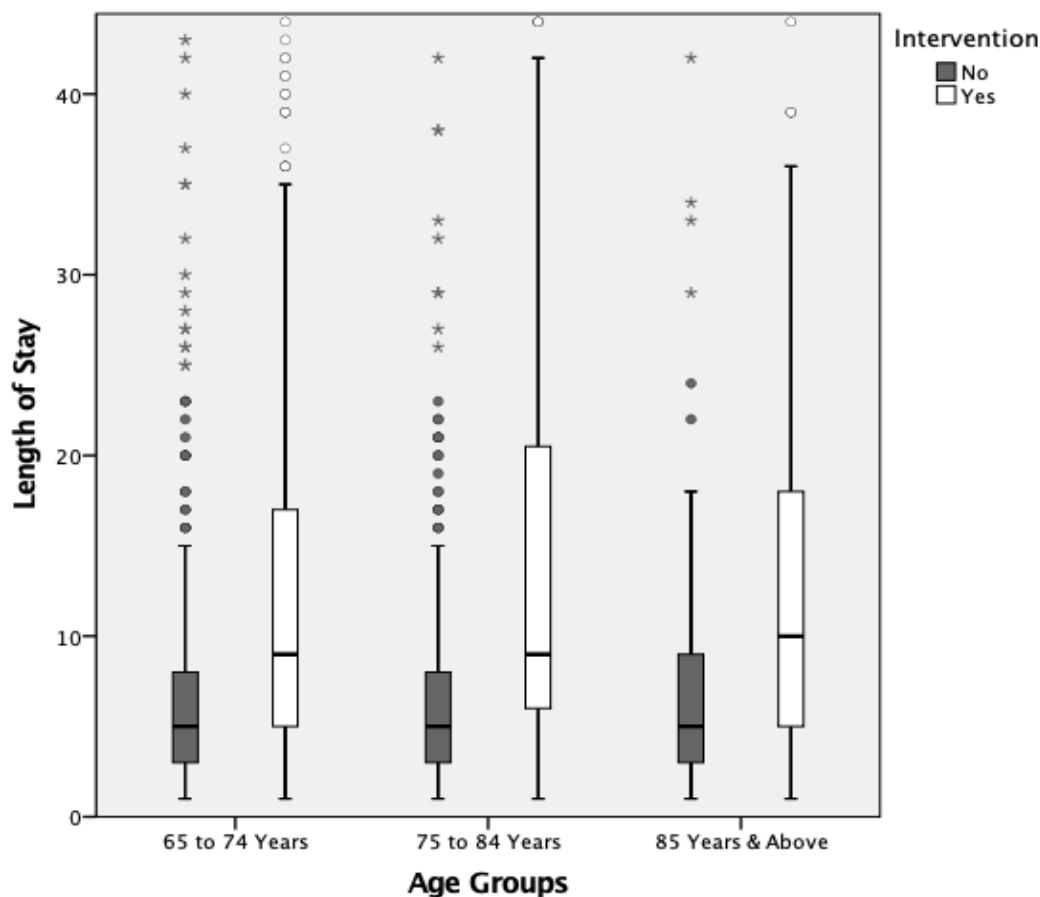


Figure 1: Effect of acute intervention on the length of stay in different age groups

Groups of Episodes with similar diagnosis:

On the basis of the diagnosis at presentation the sample was stratified into seven broad categories¹²: hernia (n=71, 3.8%), lower gastrointestinal pathology (n=457, 24.3%), upper gastrointestinal pathology (n=413, 22%), skin and soft tissue pathology (n=265, 14%), neoplasm (n=171, 9.1%), vascular (n=441, 23%) and other unspecified pathology (n=62, 3%). Trends of diagnosis were consistent within all three age groups (p=0.083). The longest stays are associated with vascular pathologies and neoplasms with mean LOS of 17.88 +/- 37.33 days and 15.29 +/- 2.16 days respectively (table 3). A small percentage of patients have excessively long stays (50days) due to in hospital rehabilitation and social circumstances. The LOS is significantly influenced by the diagnosis of the patient (p=0.01). Even though the trends of diagnosis appear the same in the three age groups, neoplasm and upper GI pathologies led to higher chances of an extended LOS (>10 days) in Group 3 as compared to Group 1; 23% higher and 9% higher respectively.

Groups of Episodes with similar diagnosis	N (Percent)	Ave LOS ± SD
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Hernia	71 (3.8%)	8.06 ± 8.89
Lower GI Pathology	457 (24.3%)	10.98 ± 18.889
Neoplasm	171 (9.1%)	15.29 ± 22.162
Other Unspecified Pathology	62 (3.3%)	12.08 ± 14.002
Skin & Soft Tissue Pathology	265 (14.1%)	10.16 ± 13.861
Upper GI Pathology	413 (22%)	11 ± 14.827
Vascular Pathology	441 (23.5%)	17.88 ± 37.327
Total	1880 (100%)	12.81 ± 23.49

Table 3: Average Length of Stay according to Diagnosis Related Group

Discharge Disposition

When discharge destinations were analysed, a total of 1496 patients (79.57%) in every age group were discharged home. Of the 179 (9.52%) patients who were discharged to nursing homes or convalescent centres 118 (65.92%) were above 75 years of age. In Group 3, 52 (22%) patients were discharged to nursing homes/convalescent centres, in comparison to 61 (6.2%) in Group1 and 66 (9.8%) in Group 2, see Table 1. The diagnosis at presentation significantly affects the discharge disposition of a patient ($p < 0.001$). 1496 (79.57%) of all the acute admissions were discharged home, and this trend held consistent throughout all diagnoses. Of those discharged to nursing homes and convalescent centres a majority were diagnosed with vascular pathology and lower gastrointestinal pathology, $n=56$ (31.3%) and $n=40$ (22.34%) respectively.

Mortality

Highest proportion of mortality was noted in patients presenting with vascular pathology ($n=24$, 33.3%) followed by lower GI ($n=21$, 29.2%), Upper GI ($n=10$, 13.9%) and neoplasms ($n=10$, 13.9%). A total of 72 in hospital mortalities were recorded over the study duration of three years (3.4/100000 in 2016), 5/100000 in 2017 & 6/100000 in 2018); 45 (62.5%) of these patients were above 75 years old. In-hospital mortality for group 3 (≥ 85 yrs) was noted to be 17 (7.3%) patients, followed by Group 2 ($n=28$, 4.2%) in comparison to group1 that had a mortality of 27 (2.7%) patients exhibiting a significant difference among age groups ($p=0.01$).

Subset of the sample with extended length of stay

In the study sample, 494 patients (26.27%) had a LOS above the aveLOS of the entire study sample with a male to female ratio of 1.4:1. When we focus on the age of patients in this extended hospital stay subset, the highest percentage belongs to the younger age group 1 ($n=241$, 48.8%) followed by group 2 ($n=184$, 37.2%) and then group 3 ($n=69$, 14%).

Subgroup analysis performed for LOS noted no significant correlation with gender (Pearson's $R = -0.05$) or GESD ($R = 0.06$).

Similar trends were noted as previously stated in reference to GESD; 148 patients (30%) were diagnosed with a vascular pathology while GI pathologies accounted for 192 patients (38.8%) (See table 3). 380 (76.9%) patients underwent an acute surgical intervention, however, when analysed versus LOS there is no significant effect of intervention performed on the length of hospital stay ($p = 0.22$).

Of the interventions performed, 235 (47.6%) had a procedure under General Anaesthesia, 110 (22.3%) had emergency scopes and 35 (7.1%) had interventional radiological procedures. Acute intervention or type of procedure performed in these patients did not significantly increase the LOS and univariate linear regression analysis performed confirmed this finding. (IR $p = 0.91$) (Scopes $p = 0.99$) (G/A $p = 0.062$).

Discussion

This study investigates age as an independent predictor for increased hospital stay following acute surgical admissions in a population over the age of 65 years.

Although frailty and comorbidities, in elective surgical settings, have been described in literature to be associated with extended LOS¹³, the absence of frailty measurements in emergency settings due to time constraints and financial limitations has led us to explore the effect of additional independent variables; age, GESD (groups of episodes with similar diagnosis), acute intervention on LOS, discharge disposition and mortality. The LOS is depictive of complexity of post-operative care, efficiency of discharge to community, ability to cope with stress of acute illness and cost effectiveness of health system.

Although increasing data suggests age-related increase in LOS, most existing literature focuses on the outcomes of elective surgical care or comparison of elderly with a younger cohort. Our study explores the effect of age on LOS in an acute surgical setting and our analysis suggests that age alone is not a significant predictor of increased LOS among elderly acute surgical admissions above 65 years of age. Likewise, CP Luanay et al have recently described in a prospective cohort (≥ 65 years) concluding that effect of age was minimal on predictive abilities for long hospital stays¹⁴.

We found that the GESD and an acute intervention affects LOS irrespective of age. Longest hospital stays are associated with neoplasms and vascular pathologies and patients who underwent a procedure under general anaesthesia. Braulio A. Marfil-Garza et al looked into Mexican experience over 18 years' time scale. A large spectrum of diseases was identified which were associated with prolonged LOS including hematopoietic neoplasms (aOR 2.82, 95% CI 2.40–3.32), diseases of the peritoneum (aOR 2.82, 95% CI 2.33–3.41), complex

intestinal and abdominal disorders (aOR 2.56, 95% CI 1.98–3.32) and sepsis and severe bacterial infections (aOR 2.21, 95% CI 1.78–2.72) were most notable. The group also identified that emergency hospitalizations that required any type of surgical intervention (“emergency, surgical”) had the highest risk of PLOS in comparison to “elective, non-surgical” events of hospitalization (aOR 5.07, 95% CI 4.84–5.30).

Diagnosis and type of acute intervention predicts increased LOS which can be illustrative of complexity in post-operative care and management, as supported by literature.

Mortality rate is the only outcome being significantly influenced by age at presentation. In-hospital mortality of group 3 (7.3%) was significantly higher than the relatively younger study age groups, which points to the increased vulnerability and fragility in this age group. Similarly, E St Louis et al retrospectively reviewed acute surgical population among elderly (>80 years) and non-elderly (<80 years), identified a higher mortality risk among patients above 80 years; 1.9% and 11.7% respectively ($p < 0.001$)⁹. H. Linkhorn et al, in their study, looked at acute surgical care and concluded the risk ratio of death in hospital for patients over 80 years was 36.4 times higher than patients under 80 years⁵.

Analysis of the patient subset with an above average LOS showed no significant correlation or effect of increasing age on the LOS, implying that possible logistical or administrative factors influence the discharge disposition of these patients. It has also been stated in previous literature that most of the LOS variation is not explained by clinical factors and may be explained by nonclinical factors; logistical delays, insurance type¹⁵.

Age alone is a poor predictor of LOS. For patients above 65 years in acute surgical settings, the clinical factors associated with increased LOS are diagnosis related category, acute intervention and the type of procedure performed.

Most extended LOS cannot be explained by clinical factors. Once patients exceed average LOS, resources such as ARHC (age-related health care) should be explored to facilitate discharge planning. Prospective studies taking frailty measurements into account should be carried out for identifying target areas for quality improvement in efficiency of care. Further studies are needed focussing on acute surgical outcomes for development of acute care models based on non-clinical factors potentially causing extended in-hospital stays.

Declarations of Conflicts of Interest:

None declared.

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