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Outcomes of elderly trauma patients in South African level 1 trauma centres – a retrospective study

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Background: A rapidly ageing population and dramatic changes in the lifestyles of the elderly make it compelling to understand trauma in the elderly better. Overall outcomes in elderly trauma patients are essential to examine, given the costly burden attached to trauma for this population group. The aim of this study is to examine the outcomes of elderly trauma patients presenting to three level 1 South African trauma centres.
Methods: The study conducted a retrospective analysis on elderly patients between 1 January 2013 and 31 December 2016. The inclusion criteria comprised elderly individuals aged 65 years and above with an injury severity score (ISS) exceeding 10. Sixty-two elderly trauma patients met these criteria. Demographic information, mechanism of injury, length of hospital stay, in-hospital mortality outcome, and comorbidities were analysed. Descriptive statistics and chi-square tests were performed using STATA version 17. A *p*-value of less than 0.05 was considered statistically significant, indicating a meaningful association between variables.
Results: Sixty-two elderly trauma patients met the inclusion criteria. The study revealed highly significant negative associations between patients' survival and key exposure variables, including the emergency department revised trauma score (RTS) (Rho = 0.481, $p = 0.002$), arterial pH (Rho = 0.378, $p = 0.008$), days spent in the high care unit (Rho = 0.586, days spent in the ward (Rho = 0.463, p = 0.004), Glasgow Coma Scale (GCS) score (Rho = -0.538, p $p = 0.000$), brain abbreviated injury score (BAIS) (Rho = -0.525, $p = 0.001$), fraction of inspired oxygen level (FiO2) (Rho = -0.410, $p = 0.008$), blood creatinine level (Rho = -0.409, $p = 0.003$), and APACHE score on admission (Rho = 0.599, $p = 0.001$).
Conclusion: Overall, these findings suggest that factors such as severity of illness (APACHE scores), duration of ICU stay, and mode of injury play significant roles in patient outcomes across hospitals, while the impact of surgical intervention on mortality warrants further investigation due to weaker evidence. The findings underscore the direct influence of presenting physiology, injury severity, and comorbid medical conditions on outcomes for elderly trauma patients. Recognising and addressing these factors are paramount for delivering effective and tailored care to elderly trauma patients, ultimately enhancing their prospects for recovery and improved quality of life.
Keywords: elderly, trauma, outcomes, comorbidities

Introduction

Geriatric trauma, defined as physical injuries occurring in elderly individuals, is a critical concern in healthcare. While the precise age threshold for categorising someone as "elderly" in trauma literature varies, most studies consider individuals aged 65 and older as geriatric.[1] The global population of older adults has been steadily increasing, as highlighted by a United Nations report from April 2002.[2] The significance of addressing elderly trauma has been acknowledged in the literature for several decades.[3-5] Trauma can have a profound and complex impact on the lives of elderly patients.[6] Studies have demonstrated an elevated risk of mortality in injured elderly individuals, with the likelihood of death increasing for each year beyond the age of 65.[7,8] Additionally, the financial burden of elderly trauma on the healthcare sector and the overall economy is substantial.[4,7]

The ageing population, coupled with the desire for independent living, has elevated the risk of traumatic injuries among the elderly, with motor vehicle accidents playing a prominent role.[1,9] Developing countries, often faced with limited resources, are particularly challenged by the substantial trauma burden, which includes both elderly and young trauma patients.[10]

Clinical management of elderly trauma patients necessitates careful consideration of their physiological responses to trauma, along with the presence of comorbid medical conditions.[7,11] Elderly patients tend to present with a higher prevalence of medical comorbidities compared to their younger counterparts, making them less resilient to severe injuries.[12] Physiological changes associated with ageing, including decreased bone mass, diminished balance, and slower reaction times, predispose the elderly to fall-related injuries.[13] Moreover, the use of certain chronic

medications, such as antiplatelet drugs and anticoagulants, increases the risk of haemorrhagic complications.[9] Post-trauma, elderly individuals experience a decline in functional capacity, requiring extended hospitalisation for recovery and rehabilitation.[14]

The context in low- to middle-income countries (LMICs) differs from that in higher-income countries, as South Africa and many other developing nations predominantly contend with a younger population burdened by trauma, particularly young males.[11] Understanding the burden of disease in both state and private facilities may shed more light on this growing global trauma burden.

This study aims to assess the outcomes of elderly trauma patients with moderate to severe injury burdens in three major trauma units in Johannesburg.

This research may offer valuable insights into the unique challenges and issues faced by elderly trauma patients in a resource-constrained environment with a high prevalence of traumatic injuries.

Methods

This retrospective study encompasses data collected from 1 January 2013 to 31 December 2016. The study cohort comprises elderly trauma patients aged 65 years and older who presented with an injury severity score (ISS) exceeding 10. All patients included in this investigation were admitted to high-dependency units within three distinct trauma centres, herein designated as hospitals 1 (a government/public hospital), 2 (a private hospital), and 3 (another private hospital). Data were meticulously extracted from various sources, including patient records, resuscitation documentation, and intensive care unit (ICU) charts.

The data fields that were recorded were patient demographics, pre-hospital level of care, presenting physiology in the emergency room including blood gas analysis, the type and cause of injury, the severity of the injury, and trauma severity scores. Further information collected included complications in hospital, surgical procedures done and whether the patient survived or demised.

Statistical analysis was conducted utilising STATA software, version 17, with a confidence interval set at 95%. Descriptive analysis – initial data exploration involved the creation of frequency tables to depict the prevalence and distribution of various data elements visually. Bivariate analysis – chi-square tests were employed to assess associations between nominal variables and ordinal variables. This analysis sought to identify significant relationships between variables, such as the hospital type (hospitals 1, 2, or 3) and the likelihood of managing patients with specific clinical profiles. Statistical significance – significance in this study was defined by a *p*-value less than 0.05, indicating meaningful statistical associations or disparities.

Ethical approval was diligently obtained from the University of the Witwatersrand Human Research Ethics Committee (Medical), with clearance number M170688. Additionally, explicit permission was granted from the three data collection site managers and the Private Research Committee. The utmost care was taken to handle patient records with complete confidentiality and in compliance

Table I: Patient demographic characteristics, level of care and mode of injury (*n* = 62 cases)

Chi-square tests		Hospital number						Total	*p*-value
		1		2		3			
		n	%	*n*	%	*n*	%		
Age group	65–70 years	13	61.90	18	75.00	7	41.18	38	**0.091
	71–90 years	8	38.10	6	25.00	10	58.82	24	
Race	Black	12	57.14	2	8.33	0	-	14	*< 0.001
	Coloured	2	9.52	0	-	0	-	2	
	Indian	3	14.29	0	-	1	5.88	4	
	White	4	19.05	22	91.67	16	94.12	42	
Transferred	No	17	80.95	17	70.83	9	52.94	43	0.173
	Yes	4	19.05	7	29.17	8	47.06	19	
Prehospital level of care	ALS	5	23.81	10	41.67	11	64.71	26	0.114
	BLS	8	38.10	5	20.83	1	5.88	14	
	Doctor	1	4.76	0	-	0	-	1	
	ILS	7	33.33	9	37.50	5	29.41	21	
Mode of injury	Blunt: MBC	0	-	0	-	1	5.88	1	*0.001
	Blunt: MVC	6	28.57	9	37.50	4	23.53	19	
	Blunt: Other	3	14.29	4	16.67	0	-	7	
	Blunt: PVC	8	38.10	1	4.17	0	-	9	
	Blunt: Fall	3	14.29	6	25.00	10	58.82	19	
	Burns	1	4.76	0	-	1	5.88	2	
	Penetrating: GSW	0	-	4	16.67	0	-	4	
	Penetrating: other	0	-	0	-	1	5.88	1	
	Total	21	100.00	24	100.0	17	100.00	62	

*Significant at 5% level, **Significant at 10% level
PVC – Pedestrian vehicle collision, MVC – Motor vehicle collision, MBC – Motor bike collision, GSW- Gunshot Wounds, BLS – Basic life support, ILS – Intermediate life support, ALS – Advanced life support

with all relevant ethical guidelines to protect patient privacy and data security.

Results

Demographic characteristics and mode of injury

Table I presents the demographic characteristics and mode of injury for patients at each hospital. Notably, patients in the 65–70 years age group and those aged 71 and above exhibited longer hospital stays in hospitals 2 and 3, respectively. The study findings reveal a significant negative association between patient age and survival in trauma care. The predominant types of injuries were motor vehicle collisions (MVC) and fall injuries, both categorised as blunt injuries. Notably, MVC cases were most frequent in hospitals 2 and 3.

Emergency room variables

Table II details various emergency room variables. Most patients presented with a systolic blood pressure exceeding 90 mmHg and exhibited minor head injuries. The majority of patients had an immediate priority revised trauma score (RTS), and blood lactate levels were primarily below 4 mmol/L. Base deficit levels did not significantly differentiate between patients who presented worse or better than -4. As expected within the elderly age group, many patients presented with more than one comorbid medical condition.

Clinical assessment and complications

The analysis of complications within different physiological and anatomical bodily systems (Table III) revealed that, for each system, most patients did not develop complications. The complications grouped into various categories based on the affected systems or organs, such as the central nervous system, chest (thorax), cardiovascular system (CVS), gastrointestinal tract (GIT), genitourinary system (renal), joints, and other complications did not show significant associations with the hospital that the patient attended ($p > 0.05$). Notably, weak evidence (10% significance) occurs between the central nervous and genitourinary system (renal) systems and hospital attended. Table IV shows associations in mortality between patients who underwent a surgical procedure and those who did not, according to hospital. Overall, acute physiology and chronic health

Table II: Various emergency room variables for patients in the 62 cases

		Hospital number						Total	*p*-value
		1		2		3			
		n	%	*n*	%	*n*	%		
Systolic blood pressure (SBP)	≤ 90 mmHg	3	14.29	4	16.7	5	29.41	12	0.646
	91–159 mmHg	12	57.14	15	62.5	7	41.18	34	
	≥ 160 mmHg	6	28.57	5	20.8	5	29.41	16	
Glasgow Coma Scale (GCS)	3–8	7	33.33	6	25.0	11	64.71	24	**0.083
	9–12	0	0.00	1	4.2	0	-	1	
	13–15	14	66.67	17	70.8	6	35.29	37	
Revised trauma score (RTS)	12	0	0.00	16	66.7	1	5.88	17	*< 0.001
	3–10	21	100.00	8	33.3	16	94.12	45	
Blood lactate level	Lactate < 4 mmol/L	19	90.48	21	87.5	12	70.59	52	0.209
	Lactate > 4 mmol/L	2	9.52	3	12.5	5	29.41	10	
Base deficit	> -4	14	66.67	18	75.0	7	41.18	39	**0.079
	≤ -4	7	33.33	6	25.0	10	58.82	23	
Comorbidity medical conditions	None	4	19.05	9	37.5	6	35.29	19	*0.025
	One	12	57.14	5	20.8	2	11.76	19	
	> 1	5	23.81	10	41.7	9	52.94	24	
Total		21	100.00	24	100.0	17	100.00	62	

*Significant at 5% level, **Significant at 10% level

Table III: Complications

Complications developed in		Hospital number						Total	*p*-value
		1		2		3			
		n	%	*n*	%	*n*	%		
Central nervous system	Cerebral vascular accident	0	0.00	1	4.2	4	23.53	5	**0.093
	Frontal lobe syndrome	0	0.00	1	4.2	0	-	1	
	Hygroma	0	0.00	1	4.2	0	-	1	
	None	18	85.71	19	79.2	8	47.06	45	
	Raised intracranial pressure (ICP)	2	9.52	2	8.3	3	17.65	7	
	Seizures	1	4.76	0	-	2	11.76	3	

Table III: Continued

Complications developed in		Hospital number						Total	*p*-value
		1		2		3			
		n	%	*n*	%	*n*	%		
Chest (Thorax)	Adult respiratory distress syndrome (ARDS)	2	9.52	4	16.7	0	-	6	0.406
	Complicated haemothorax	0	0.00	0	-	1	5.88	1	
	Lower respiratory tract infection (LRTI)	2	9.52	3	12.5	1	5.88	6	
	None	15	71.43	12	50.0	14	82.35	41	
	Pleural effusion	1	4.76	2	8.3	1	5.88	4	
	Pneumothorax	0	0.00	1	4.2	0	-	1	
	Pulmonary embolus & respiratory failure	0	0.00	2	8.3	0	-	2	
	Respiratory failure	1	4.76	0	-	0	-	1	
Cardiovascular system (CVS)	Cardiac failure	0	0.00	2	8.3	1	5.88	3	0.173
	Deep vein thrombosis	0	0.00	2	8.3	0	-	2	
	None	19	90.48	19	79.2	11	64.71	49	
	Rapid atrial fibrillation	0	0.00	0	-	1	5.88	1	
	Septic shock	2	9.52	0	-	3	17.65	5	
	Supraventricular tachycardia (SVT) & haemodynamic collapse	0	0.00	0	-	1	5.88	1	
	Vertebral artery occlusion	0	0.00	1	4.2	0	-	1	
Gastrointestinal tract (GIT)	Bowel necrosis due to mesenteric embolus	0	0.00	0	-	1	5.88	1	0.581
	Clostridium Difficile (C. diff) diarrhoea	0	0.00	1	4.2	1	5.88	2	
	Diarrhoea	0	0.00	1	4.2	0	-	1	
	Faecal loading	0	0.00	1	4.2	0	-	1	
	Gangrenous cholecystitis	0	0.00	2	8.3	0	-	2	
	Gastric outlet obstruction	0	0.00	1	4.2	0	-	1	
	Ileus	1	4.76	1	4.2	1	5.88	3	
	None	19	90.48	17	70.8	14	82.35	50	
	Tertiary peritonitis	1	4.76	0	-	0	-	1	
Genitourinary System (renal)	Acute kidney injury	0	0.00	5	20.8	5	29.41	10	**0.0926
	None	19	90.48	15	62.5	9	52.94	43	
	Renal failure	1	4.76	2	8.3	3	17.65	6	
	Urinary tract infection (UTI)	1	4.76	2	8.3	0	-	3	
Joints	Haemarthrosis	0	0.00	1	4.2	0	-	1	0.469
	None	20	95.24	23	95.8	17	100.00	60	
	Joint sepsis	1	4.76	0	-	0	-	1	
Other Complications	Delirium	0	0.00	1	4.2	0	-	1	0.602
	None	15	71.43	18	75.0	12	70.59	45	
	Pressure sores	2	9.52	1	4.2	0	-	3	
	Rhabdomyolysis	0	0.00	0	-	1	5.88	1	
	Sepsis	2	9.52	3	12.5	4	23.53	9	
	Skin infection	1	4.76	0	-	0	-	1	
	(SIRS)	1	4.76	1	4.2	0	-	2	
Total		21	100.00	24	100.0	17	100.00	62	

*Significant at 5% level, **Significant at 10% level

Table IV: Mortality

Final patient outcome			Hospital number						Total	*p*-value
			1		2		3			
			n	%	*n*	%	*n*	%		
Surgical intervention	Alive	None	6	28.57	5	20.83	0	-	11	**0.068
		1 operation	2	9.52	4	16.67	4	23.53	10	
		≥ 2 operations	2	9.52	8	33.33	2	11.76	12	
	Died	None	5	23.81	4	16.67	3	17.65	12	0.741
		1 operation	5	23.81	2	8.33	6	35.29	13	
		≥ 2 operations	1	4.76	1	4.17	2	11.76	4	
APACHE score	Alive	3–10	3	14.29	5	20.83	1	5.88	9	*0.012
		11–20	6	28.57	11	45.83	1	5.88	18	
		21–30	1	4.76	1	4.17	1	5.88	3	
		31–40	0	-	0	-	3	17.65	3	
	Died	3–10	1	4.76	2	8.33	0	-	3	0.135
		11–20	3	14.29	2	8.33	0	-	5	
		21–30	6	28.57	3	12.50	8	47.06	17	
		31–40	1	4.76	0	-	3	17.65	4	
Days in ICU	Alive	< 10 days in ICU	8	38.10	7	29.17	3	17.65	18	0.143
		10 ≥ days in ICU	2	9.52	10	41.67	3	17.65	15	
	Died	< 10 days in ICU	9	42.86	6	25.00	4	23.53	19	*0.035
		10 ≥ days in ICU	2	9.52	1	4.17	7	41.18	10	
			21	100.00	24	100.00	17	100.00	62	

*Significant at 5% level, **Significant at 10 % level, ICU – Intensive care unit

Table V: Mode of injury vs prevalence of mortality

Final patient outcome vs mode of injury			Hospital number						Total	*p*-value
			1		2		3			
			n	%	*n*	%	*n*	%		
Alive	Mode of injury	Blunt trauma	10	47.6	15	62.5	6	35.3	31	0.210
		Penetrating trauma	0		2	8.33	0	-	2	
Died	Mode of injury	Blunt trauma	10	47.6	5	20.8	9	52.9	23	*0.04
		Burns	1	4.8	0	-	1	5.9	2	
		Penetrating trauma	0	-	2	8.33	1	5.9	3	
			21	100	24	100	17	100	62	

*Significant at 5% level, **Significant at 10% level
Blunt trauma – Pedestrian vehicle collision + Motor vehicle collision + Motor bike collision + Falls + Blunt assault
Penetrating trauma – All stabs + Gunshot wounds

evaluation (APACHE) scores showed strong significant associations (p = 0.012) with mortality, a higher APACHE score was also associated with death, particularly in hospital 3 (p = 0.012). ICU stay (days) was also significantly associated with mortality (p = 0.04), a stay of fewer than 10 days was likely to have higher odds of mortality, especially in hospital 3. Hospital 3 had the highest mean days spent in the ICU (20 days) and days spent on a ventilator (15 days). There was weak evidence on the association between surgical intervention and mortality (p = 0.068), suggesting patients who had an operation were at higher risk of mortality, especially in hospital 2 compared to hospital 1. Table V highlights associations between the mode of injury and mortality at the different hospitals. Mode of injury was a strong predictor of mortality (p = 0.04). Blunt injuries, mainly falls, resulted in the highest mortality in hospital 3, while MVC and pedestrian vehicle collision (PVC) were likely to cause deaths in hospital 1.

Discussion

Epidemiology

The demographic characteristics of the patients in this study highlight the predominance of the 65–70-year age group, which constituted the majority (62%) of the study population. In line with other international studies, our findings demonstrate a male predominance among elderly trauma patients, with 77% being male. Notably, gender distribution can vary in regions and populations, as evidenced by Italy,[7] South Africa,[11] and Japan[14] studies.

Physiology

Prehospital care for elderly trauma patients emerged as a critical factor influencing overall outcomes. Studies from the United Kingdom and the United States, reflect the need for more comprehensive triage tools for the elderly emphasising the significance of prehospital care.[15-17] These findings underscore the need for focused attention on optimising the prehospital management of elderly trauma patients to enhance their survival prospects.

Injury mechanisms

Our study predominantly identified blunt mechanisms of injury, with MVC and falls being the most common causes. These findings align with similar studies in elderly trauma patients worldwide, emphasising that falls are a primary injury mechanism in the elderly.[7,9,11] Acknowledging that local factors, lifestyle, and infrastructure may influence injury patterns is essential.

Physiological parameters

Our study highlighted the distribution of systolic blood pressure, GCS, RTS, blood lactate levels, and base deficits. Most patients presented with relatively stable vital signs, minor head injuries, and favourable physiological parameters. This is consistent with the concept that elderly hypotensive patients may exhibit higher blood pressure levels than younger individuals, emphasising the need for age-specific assessment and management protocols.[18]

Comorbidities

The prevalence of comorbid medical conditions in our study population emphasises the complex nature of elderly trauma patients' medical profiles. Hypertension emerged as a common comorbidity, reinforcing the link between pre-existing diseases and trauma outcomes. Cardiovascular disease and the use of specific medications can complicate resuscitation efforts, highlighting the importance of individualised care plans and close monitoring.[11]

Outcomes

The study revealed that elderly patients were more likely not to survive their injuries than younger patients. This trend aligns with the findings of other international studies.[19] Nevertheless, it is essential to consider variations in mortality rates across studies, as these differences may be attributed to various factors, including sample size, injury severity, and patient comorbidities.

Hospital-specific mortality rates

The significant variation in mortality rates among the hospitals studied highlights the impact of hospital-specific factors on patient outcomes. Hospital 1 demonstrated better survival outcomes, whereas hospital 3 had the highest mortality rate. Differences in patient injury profiles and variations in hospital resources, care protocols, and healthcare providers can contribute to these disparities. The role of hospital-specific factors in determining outcomes underscores the importance of quality improvement initiatives and benchmarking.

ICU and ventilator days

The prolonged ICU and ventilator days observed in this study underscore the complex and severe nature of injuries sustained by elderly trauma patients. These findings align with the general understanding that older patients with moderate to severe trauma require extended critical care and mechanical ventilation. The shorter stays in the high care unit and general ward are consistent with standard patient progression following stabilisation. The differences between state and private hospitals and the distinct patient populations served can contribute to variations in healthcare utilisation.

RTS and survival outcomes

Our study highlights the value of the RTS as a predictor of trauma patient outcomes. A lower RTS was inversely associated with patient survival, reinforcing the predictive significance of this score. This observation supports the importance of including RTS in trauma assessment and management protocols.[11]

Base deficit on blood gas analysis

The study revealed a high proportion of patients with a base deficit, emphasising the potential for metabolic disturbances in the elderly trauma population. Base deficits can reflect underlying physiological derangements and haemodynamic instability. Identifying and addressing these disturbances is crucial for optimising patient care and outcomes.

Renal dysfunction and dialysis

A noteworthy number of patients with renal dysfunction did not require renal dialysis in this study. This finding aligns with the understanding that not all elderly trauma patients with renal dysfunction will necessitate dialysis.[20] Individualised treatment plans should consider factors such as the extent of renal impairment and the overall clinical picture.

Surgical procedures

The high percentage of patients undergoing surgical procedures aligns with standard trauma care practices, where surgery is often necessary to address injuries and stabilise patients.[21] Timely surgical intervention is emphasised as a key element in trauma care to prevent complications and enhance patient outcomes.[22]

GCS and survival outcomes

The study reinforces the importance of the GCS as a prognostic tool in trauma care. The association between lower GCS scores and increased mortality risk underscores the predictive value of GCS in assessing brain injury severity and overall patient outcomes.[23]

Associations with survival

The observed associations between variables such as GCS, BAIS, FiO2, and blood creatinine level and survival highlight the multifaceted nature of trauma care in the elderly.[20] These variables provide valuable insights into the factors that impact patient outcomes and the need for targeted interventions.

APACHE score on admission

The strong positive association between the APACHE score on admission and survival underscores the value of this score in assessing the severity of illness and prognosis in critically ill patients. Using the APACHE score as an early assessment tool can help identify high-risk patients and guide treatment strategies.[24]

Positive associations with survival

The positive associations between the RTS and arterial pH with survival reflect the significance of favourable physiological parameters in enhancing patient outcomes.[25] These findings support the need for comprehensive assessment and management of these parameters to improve trauma care.

Overall impressions

The study provides valuable insights into the outcomes of elderly trauma patients in South Africa, emphasising the challenges and disparities faced by this population. The recommendations presented, including creating safer environments and raising awareness, address the critical need for improved elderly trauma care in the country. The study also acknowledges the rising proportion of elderly patients, highlighting the need for targeted strategies to optimise trauma care for this vulnerable group, and the varying mortality rates among hospitals.

Study limitations

This study has a relatively small sample size of 62 elderly trauma patients, limiting the generalisability of findings to the broader South African elderly population. The study's regional specificity, focusing on three trauma centres in a particular region, may not fully represent trauma outcomes in other parts of the country. Data completeness and accuracy may vary due to the study's retrospective nature. The study acknowledges comorbid medical conditions but does not extensively explore their impact on patient outcomes. Additionally, the single-centre focus on three trauma centres may not capture the full range of trauma care settings. Resource constraints and potential selection bias based on injury severity may affect the study's results. In summary, while the study provides valuable insights, its limitations related to sample size, regional focus, data completeness, comorbidity assessment, healthcare settings, resource constraints, and potential selection bias should be considered when interpreting the findings.

Conclusion

This study enhances our comprehension of trauma care for elderly patients and underscores the imperative to improve their outcomes in South Africa. It offers valuable insights into trauma outcomes among the elderly in South Africa, emphasising the elevated load differences between the state facility and the two private facilities in those with an ISS > 9. It underscores the necessity for tailored interventions and enhancements in trauma care for the elderly population.

Conflict of interest

The authors declare no conflict of interest.

Funding source

No funding was received for the study.

Ethical approval

Ethical approval was diligently obtained from the University of the Witwatersrand Human Research Ethics Committee (Medical), with clearance number M170688.

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