Shooting up? Analysis of 182 gunshot injuries presenting to a London major trauma centre over a seven-year period

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ABSTRACT

INTRODUCTION Metropolitan Police data, and those from the emergency department at a London major trauma centre show a resurgence in gun crime. The aim of this study was to collect data on all gunshot injuries over a seven-year period at South-East London's trauma hub.

MATERIALS AND METHODS This was a retrospective observational study of all gunshot injuries between 1 January 2010 and 31 December 2016 at a London major trauma centre. Information regarding patient demographics, morbidity and mortality was collected. Data from the English indices of multiple deprivation were reviewed in relation to shooting locations and socioeconomic status in South-East London.

RESULTS A total of 182 patients from 939,331 emergency admissions presented with firearm injuries. Males comprised 178 (97.8%) victims and 124 (68.1%) were documented as being Black or Afro-Caribbean. The median age was 22 years. Some 124 (71.7%) victims were shot within a 4 km radius of the hospital. The mean indices of multiple deprivation decile ranking in shooting locations compared with non-shooting locations was 2.6 (± 0.1384) and 3.8 (± 0.1149), respectively. A total of 122 (67.0%) patients underwent specialist operative intervention and 111 (61.0%) suffered only superficial or musculoskeletal injuries. Six patients required emergency thoracotomies; three (50.0%) survived to discharge. The median length of stay was 4 days (interquartile range 2–9 days) and 35 (24.0%) were admitted to intensive care. Ten (5.5%) patients died.

DISCUSSION AND CONCLUSION Firearms injuries are increasing and place a significant burden on hospital resources. Care provided to gunshot victims has improved as a result of recent trauma management initiatives at South-East London's major trauma centre.

KEYWORDS

Epidemiology – Penetrating injury – Gunshot injuries – Gun – Trauma – Inner-city – United Kingdom

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Introduction

The majority of gun crime consistently takes place in England's metropolitan centres of Greater London, Greater Manchester and the West Midlands.^{1,2} Gunshot injuries are estimated to comprise 18.6% of UK penetrating trauma, while stabbings are responsible for 75.2%.³ Metropolitan Police data, together with those from our emergency department at a London major trauma centre, show that after several years of steady decline, there has been a recent resurgence in gun crime. June 2017 saw the latest publication of data showing a progressive three-year increase in both gun crime and homicides in England and Wales. Furthermore, 50% of the gun crime increase was seen in the London metropolitan area and NHS data indicated a nationwide increase in gunshot injury-related admissions.⁴

A large review of firearm injuries in Manchester between 1995 and 2000 by Cowey *et al.* concluded that while gunshot

injuries can be relatively minor and managed conservatively, they may be extremely demanding and require expertise beyond the scope of a single specialist surgeon. We believe this to be the authoritative UK firearm injury analysis until now, highlighting the lack of consistent and contemporary high-calibre research in this field.⁵

King's College Hospital is a 950-bed teaching hospital serving a population of 700,000. In 2010, it became one of the four major trauma centres in London and in 2013 the South-East London, Kent and Medway Major Trauma Network was established, with King's College Hospital as its central hub. The network provides effective transport and treatment for trauma patients across South-East England via land ambulance and helicopter. There is a disproportionate rate of gun crime within the population surrounding our centre; between 2008 and 2013, 14.8% of all metropolitan crimes involving firearms occurred in the surrounding

boroughs of Lambeth and Southwark, despite this region comprising only 7.4% of London's 8.5 million population.^{6,7}

The aim of this study was to review data regarding epidemiology of gunshot victims, as well as the characteristics and management of the injuries sustained. We hypothesise that the quality of care afforded to firearm injuries at King's College Hospital before and after the transition to a major trauma centre has improved. Holistic gunshot data from King's College Hospital has been collected on two previous occasions, between 1993–95 and 2003–05.^{8,9}

Materials and methods

We conducted a retrospective review of data relating to all patients sustaining gunshot injuries presenting to the emergency department of South-East London's major trauma centre between 1 January 2010 and 31 December 2016.

Data collection

Emergency department and hospital electronic patient records were analysed to verify eligibility and provide information regarding: patient demographics, arrival information, police involvement, injury intent, injury characteristics and their management, hospital and intensive therapy unit length of stay and patient mortality. Sixteen patients were excluded as they presented with air-rifle ($n = 12$) or old firearm ($n = 4$) injuries. Postcodes of the shooting locations were obtained from Metropolitan Police firearm incident reports, emergency department admission documents and ambulance or helicopter runsheets. The authors also evaluated data related to the crime, ethnicity and population of South-East London made available by the Office for National Statistics, the Home Office and the Ministry of Justice.^{3,6,7,11–14}

Definitions

Serious youth violence is defined as any offence of most serious violence or gun crime or knife crime, where the victim is aged 1–19 years. Gun crime is defined as any offence with evidence of involvement of a firearm falling within the major offence categories of violence against the person, sexual offences, robbery and burglary. Gun crime with weapon fired is the same as the previous definition but only includes offences in which a firearm is discharged. Knife crime is defined as any offence involving a knife which falls within the previously mentioned major offence categories of violence. These definitions are shortened versions of those employed by the Home Office.¹⁰ Out of hours (OOH) is defined as any time outside of 8am to 6pm, Monday to Friday, and end of the week is defined as Thursday to Saturday.

Geospatial analysis

We analysed data and maps from the English indices of multiple deprivation, a UK government programme ranking relative social and economic deprivation in small regions, named lower super output areas, into deciles on a nationwide scale, with 1 being most deprived and 10 the least.¹⁴ Maps were created with the QGIS open source geographic information system.¹⁵

Statistical analysis

Statistical analyses were carried out using the chi-square and linear regression tests for association between categorical variables and logistic regression for obtaining odds ratios. A P -value less than 0.05 was deemed statistically significant. Data were analysed using Stata version 12.1.¹⁶ Each patient's revised trauma score (RTS) (based on first emergency department observations) was calculated: $RTS = 0.9368$ Glasgow Coma Score plus 0.7326 systolic blood pressure plus 0.2908 respiratory rate).¹⁷

Ethical approval

Ethical approval was obtained from the local trauma clinical governance lead; no further ethical committee approval was required.

Results

Epidemiology

Gunshot victims accounted for 182 (0.02%) of the 939,331 patients presenting to the emergency department in the 84-month period. Males comprised 97.8% of the victims ($n = 178$) and the median age was 22 years (interquartile range, IQR, 19–27). The 16–24-years age group included 57.1% of the cohort, while two patients were under the age

of 8 years and two were aged 59 years. Ethnicity was documented in 165 cases (Fig 1).

Presentations to the emergency department were associated with time of day, with the highest number ($n = 45$, 24.7%) seen between 9pm and midnight ($P < 0.001$). Most patients ($n = 152$, 83.5%) presented OOH, and 80 (44.0%) attendances took place at the end of the week. Evidence of Police involvement was documented in the ED or hospital notes in 173 (95.1%) cases.

'Intentional assault' was the acknowledged motive in 174 (95.6%) cases whilst the remainder were either 'police shooting' ($n = 4$), 'accidental' ($n = 2$) or 'self-inflicted' ($n = 2$). In 111 (61.0%) cases, the type of weapon was confirmed; with the exception of five, all were low- to medium-velocity projectiles such as handguns and shotguns. There were four cases in which a machine gun was used and the police shot one victim with a high-powered rifle.

Geospatial analysis

Some 83 (45.6%) patients arrived via land ambulance and 50 (27.5%) by the helicopter emergency service. The remaining 49 (26.9%) patients self-presented: 13 via private transport, 16 walked in, and in 20 cases the mode of self-presentation was unknown. We were able to confirm 173 (95.1%) shooting locations using postcodes provided by both Metropolitan Police reports and ambulance runsheets. The majority of victims ($n = 121$, 70.0%) were shot in the local boroughs of Lambeth ($n = 76$) and Southwark ($n = 45$). The remainder arrived from Lewisham ($n = 19$), Greenwich ($n = 8$), Croydon ($n = 5$), Bromley ($n = 4$), Bexley ($n = 3$), Wandsworth ($n = 3$), Hackney ($n = 1$) and Westminster ($n = 1$). Eight additional patients arrived from locations in South-East England, the furthest journey being 65 miles. Some 124 (71.7%) of the patients were shot within a 4km radius of the hospital.

There are 344 lower super output areas within Lambeth ($n = 178$) and Southwark ($n = 166$), with a total population of 633,332. We compared the rates of social and economic deprivation between the 265 lower super output areas in which no shootings took place and the 79 in which a shooting occurred using the English indices of multiple deprivation scale (Table 1). The 79 lower super output areas in which shootings occurred comprise 23.7% of the population of Lambeth and Southwark.

Patterns of injury

There were 302 wounds in total and in 33.5% of cases there were multiple injuries (Fig 2). Twenty-nine patients (15.9%) had some combination of intrathoracic, intra-abdominal, head and neck or musculoskeletal/superficial injuries. Nine patients (4.9%) had concomitant intra-abdominal and intrathoracic injuries. The mean revised trauma score from 180 of 182 patients was 7.39.

Intra-abdominal injuries

Thirty-three patients (18.1%) suffered from intra-abdominal injuries and 27.3% of those had an associated intrathoracic injury. Hollow viscous injury (stomach, small bowel, large bowel) was more common than solid organ injury (liver, pancreas, spleen and kidney; Table 2). The median length of hospital stay was 10 days (IQR 7–15 days) and 20 (60.6%) required time in intensive care (median length of stay 3 days, IQR 1–6 days).

Intrathoracic injuries

Twenty-two patients (12.1%) had an intrathoracic injury and 40.9% of those had a concomitant intra-abdominal injury. The median length of hospital stay was 7 days (IQR 4–11 days) and 12 (54.5%) required time in intensive care (median length of stay 2 days, IQR 1–10 days).

Table 1 Comparison of indices of multiple deprivation mean decile rankings for lower super output areas with shootings compared with lower super output areas with no shootings in Lambeth and Southwark

Index	With shootings ($n = 79$)	No shootings ($n = 265$)	<i>P</i> value
Multiple deprivation scale	2.6 ± 0.1384	3.8 ± 0.1149	$< 0.0001^a$
Income	2.8 ± 0.1645	4.0 ± 0.1392	$< 0.0001^a$
Employment	3.5 ± 0.1931	4.9 ± 0.1453	$< 0.0001^a$
Education, skills and training	6.1 ± 0.1896	6.9 ± 0.1215	0.0007^a
Health and disability	4.1 ± 0.1637	4.7 ± 0.1247	0.0242^b
Crime	1.6 ± 0.1133	2.2 ± 0.0910	0.0008^a
Barriers to housing and services	2.2 ± 0.1709	3.2 ± 0.1238	$< 0.0001^a$
Living environment	1.9 ± 0.1025	2.0 ± 0.0544	0.6976^c
Deprivation affecting children	2.3 ± 0.1413	3.2 ± 0.1312	0.0003^a
Deprivation affecting older people	1.7 ± 0.1026	2.5 ± 0.1135	$< 0.0001^a$

^a $P < 0.001$
^b $P < 0.05$
^c $P < 0.01$

Table 2 Injuries found and repaired, where appropriate, for patients with suspected intra-abdominal injuries undergoing laparotomy

	King's College Hospital (n = 29)	Cowey <i>et al.</i> ⁵ (n = 16)
Exploratory (no injuries)	2 (6.9%)	–
Stomach	5 (17.2%)	5 (31.3%)
Small bowel	19 (65.5%)	10 (62.5%)
Large bowel	10 (34.5%)	3 (18.8%)
Hepatobiliary	9 (31.0%)	6 (37.5%)
Pancreas	1 (3.4%)	1 (6.3%)
Kidney	5 (17.2%)	1 (6.3%)
Spleen	2 (6.9%)	3 (18.8%)
Bladder	0 (0.0%)	1 (6.3%)

Head and neck injuries

Twenty patients (15.4%) suffered from orbital and superficial head and neck injuries and 11 (55.0%) had no associated injuries. The median length of hospital stay was 4 days (IQR 1–10 days) and 14 (35.0%) required time in intensive care (median length of stay 3 days, IQR 1–3 days). Seven patients (3.9%) suffered from intracranial injuries, all resulting in death.

Musculoskeletal and superficial injuries

A total of 133 patients (73.1%) suffered from musculoskeletal and superficial injuries and in 111 (61.0%) of those cases there were no concomitant injuries. Fifty-four patients suffered from a thigh wound (29.7%), the most commonly injured anatomical region. The median length of hospital stay was 2 days (IQR 1–5 days) and only 14 (10.6%) required time in intensive care (median length of stay 2 days, IQR 1–3 days).

Management

Sixty patients (33.0%) were managed conservatively with dressing and suturing of wounds alongside administration of

antibiotics and analgesia, predominantly in the emergency department. The other 122 patients underwent specialist operative ($n = 117$) or palliative/organ preservation management ($n = 5$) (Table 3). Some 20.5% of these patients required operative therapy with input from more than one traditional specialty. Orthopaedics provided the majority of specialty management (52.5%) but there was significant involvement from general (23.8%) and cardiothoracic (18.9%) surgery. Thirteen patients were transferred to a different hospital for plastic surgery input, predominantly specialist wound closure. Of the 33 patients with intra-abdominal injury, 29 underwent a laparotomy. Six patients required emergency thoracotomy and four of those also needed a laparotomy.

Table 3 Management of patients undergoing specialist operative or palliative therapy		
	King's College Hospital ($n = 122$)	Cowey et al. ⁵ ($n = 97$)
Orthopaedic:	64 (52.5%)	53 (54.6%)
Debridement and washout	37	
Internal fixation	7	
Intramedullary nail	7	
Arthroscopy	6	
External fixation	3	
K-wire	3	
Fasciotomy	1	
General (laparotomy)	29 (23.8%)	16 (16.5%)
Plastic:	13 (10.7%)	6 (6.2%)
Wound closure	12	
Nerve repair	1	
Vascular	11 (9.0%)	3 (3.1%)
Cardiothoracic:	23 (18.9%)	10 (10.3%)
Chest drain	18	
Emergency thoracotomy	6	
Diaphragm repair	2	
Sternotomy	1	
VATS	1	
Maxillofacial	7 (5.7%)	
Neurosurgical	3 (2.5%)	
Ophthalmology	2 (1.1%)	
Ear, nose and throat	–	
Palliative	5 (4.1%)	–
Interventional radiology	3 (2.5%)	–

VATS, video-assisted thoracoscopic surgery.

Disposition and length of stay

The trauma team was activated for 92.5% of cases and gunshot injuries comprised 1.5% of the trauma team's workload. In total, 152 patients were admitted to the hospital, while 30 were immediately discharged, transferred to another hospital or died in the emergency department (Table 4). Of the 146 admitted patients who survived to discharge, the median length of hospital stay was four days (IQR 2–9 days) and 35 (24.0%) were at some point admitted to intensive care, with a median length of stay of 2 days (IQR 1–4 days).

Mortality

Ten patients died, resulting in a mortality rate of 5.5%. All deaths were the result of close range, execution-style shootings; the furthest distance between shooter and victim being recorded at 10–15 metres. Intent to murder was established in all ten cases. Seven patients had catastrophic intracranial injuries with no reasonable chance of survival. The remaining three patients required emergency thoracotomies, while two also underwent emergency laparotomies for intra-abdominal injuries (Table 5).

Discussion

Metropolitan Police statistics show that gun crime involving a fired weapon fell progressively between 2009 and 2015, at which point such offences began to rise once again.¹⁰ These data correlate well with our emergency department admissions (correlation coefficient $r = 0.95$); between 2010 and 2015 there was an average 17.4% annual decrease in gunshot injuries, but when comparing 2015 with 2016, there was an abrupt increase of 75.0% (Fig 3).

Table 4 Disposition of patients from the emergency department		
Department	Patients	
	(n)	(%)
Acute surgical unit	52	28.6
Ward	34	18.7
Theatre	31	17.0
General practioner	18	9.9
Intensive therapy unit	16	8.8
High dependency unit	7	3.8
Other hospital	6	3.3
Intensive therapy unit (palliative)	5	2.7
Clinical decision unit	4	2.2
Died in emergency department	4	2.2
Clinic	3	1.6
Police custody	2	1.1
Total	182	100

This recent firearm resurgence is not an isolated phenomenon; similar spikes in both knife crime and serious youth violence have emerged in recent years, highlighting the serious violent crime public health issues the UK is currently facing, particularly among younger people (Fig 4). As

a result, the topic of violent crime has returned to the fore-front of British political discourse. In April 2017, the commissioner of the Metropolitan Police Service highlighted addressing gun crime as a chief priority after statistics showed a 44.0% increase from the preceding 12 months.¹⁸

Table 5 Details of patient mortality					
Times shot (n)	Injury region	Injury detail	Management	Disposition	Cause of death
2	IC	CBI	Palliative/OP	ITU	Brain death
2	IC	CBI	Palliative/OP	ITU	Brain death
1	IC	CBI	Palliative/OP	ITU	Brain death
1	IC	CBI	Palliative/OP	ITU	Brain death
1	IC	CBI	Palliative/OP	ITU	Brain death
1	IC	CBI	–	Died in ED	Brain death
1	IC	CBI	–	Died in ED	Brain death
2	IT	RA, SVC, aorta, lung	ED ET	Died in ED	CGV injury
3	IT, IA, MSK	Liver, stomach, thigh	ET (ED), Lap (ED)	Died in ED	Liver injury
2	IT, IA	Small bowel, CIA	ET (ED), Lap (OT)	Theatre	Bowel & vascular injury

IC, intracranial; IT, intrathoracic; IA intra-abdominal; MSK, musculoskeletal; CBI, catastrophic brain injury; RA, right atrium; SVC, superior vena cava; CIA, common iliac artery; OP, organ preservation; ET, emergency thoracotomy; Lap, laparotomy; ED, emergency department; OT, operating theatre; ITU, intensive therapy unit; CGV, cardiac and great vessel; IAH, intra-abdominal haemorrhage.

We were able to find only three UK papers on gunshot wounds that included ethnographic statistics.^{8,9,19} These studies looked at gunshot admissions to King's College Hospital in the 1990s and 2000s. Across the three studies, the mean rate of Black or Afro-Caribbean victims was 66.6%. Data from our study found a similarly disproportionate rate of 68.1%. Ministry of Justice statistics from 2010 show a greater proportion of Black homicide victims were killed by shooting (25%) compared with other ethnic groups (White 4%, Asian 7% and Other 10%).¹¹ We believe that the disproportionate rate of Black victims in our study is due in part to the relative over-representation of this ethnic group in the socially deprived areas surrounding King's College Hospital. The Black community accounts for 16.7% of the 14 boroughs comprising inner London, although when considering only Lambeth and Southwark, this figure rises to 26.4%.^{12,15}

A worrying trend is noted in the rates of social and economic deprivation in the lower super output areas of Lambeth and Southwark in which shootings took place to those with no shooting activity (Fig 5). Although these areas border one another geographically, there is a notable disparity across the majority of the parameters comprising the indices of multiple deprivation. Furthermore, the rate of gunshot events per 10,000 people declined sequentially when considering the most deprived lower super output areas compared with the least deprived (Fig 6). Social factors historically well recognised in the USA as being intrinsically linked to gun crime have become similar concerns in the UK; community fragmentation, economic deprivation, social immobility and gang culture are the primary examples.^{20,21} In March 2017, the *Guardian* newspaper collated the locations of shootings across the USA using data from the Gun Violence Archive.²² Analysis concluded that half of America's

gun homicides in 2015 were clustered in just 127 metropolitan areas containing less than a quarter of the nation's population. We found a similar trend, as the shootings in Lambeth and Southwark took place in lower super output areas comprising only 23.7% of the population. Moreover, the data showed that clusters of shootings occurred within neighbourhoods blighted by intense poverty, failing schools, unemployment and racial segregation across the nation. These results correlate well with our research, reinforcing the importance of inequity and poor education as risk factors for gun crime. The researchers underscore the need to 'go local' with a targeted public health approach to break the cycle of gun crime in established hotspots.²³ Another important assertion was that, although African Americans are disproportionately exposed to more gun violence than other ethnic groups, this is not an indefinite or innate phenomenon. They highlight the endemic violence in Italian and Irish American communities in the early 20th century as examples of the cyclical nature of such associations, especially since these historical communities were also blighted by poverty, unemployment and marginalisation.

Among our cohort, 83.5% of patients presented out of hours and just 44.0% presented at the end of the week, in stark contrast to previously collected gunshot data from 1993–95 (71.0%) and 2003–05 (59.0%).^{8,9} Inner-city emergency departments should now expect firearm injuries irrespective of day, rather than predominantly towards the end of the week when major trauma has historically presented most frequently.^{5,8,9,19,24}

As of 2017, advice from the General Medical Council is that all firearm injuries, regardless of circumstance, should usually be reported to the police.²⁵ Police involvement was documented in 95.1% of cases; a strong improvement from 1993–95 (66.7%) and 2003–05 (78.2%). The continual

Figure 5 Map of the lower super output areas of Lambeth and Southwark by IMD decile rank. Coloured dots represent locations where victims were shot, and their mode of arrival to King's College Hospital (KCH). HEMS, helicopter emergency medical service; IMD, Index of Multiple Deprivation

Figure 6 Rate of shootings per population of each quintile of the Index of Multiple Deprivation scale in Lambeth and Southwark

presence of a police liaison officer in the emergency department maintains a productive and supportive relationship between department staff and local police.

Some interesting comparisons can be drawn to a knife injuries study conducted at King's College Hospital in 2011.²⁶ Knife injuries comprise a much larger proportion of the trauma team's workload and emergency department admissions; however, gunshot injuries tend to be far more

serious, with significantly higher rates of hospital admission, operative management, length of stay and mortality (Table 6). A 2008 national cost analysis of penetrating trauma estimated that each stabbing and shooting cost £7,196 and £10,307, respectively.²⁷

The average Revised Trauma Score of 7.39 represents the excellent prognosis (97% chance of survival) of the cohort in general. A considerable proportion of the cohort self-

presented (26.9%), likely a result of the sizeable number of patients with only musculoskeletal or superficial injuries (61.0%). A suspicion remains that often the intention is to maim and not kill when it comes to interpersonal violence, especially when gangs are involved for fear of disproportionate reprisals.²⁸

The mortality rate of 5.5% is low in comparison to 1993–95 (19.0%) and 2003–05 (13.0%).^{8,9} It is comparable to the Cowey *et al.* 2004 study (4.8%) but 40% of their cohort were injured by air rifles and therefore considerably more were managed conservatively (33.0% vs. 48.0%) owing to the more innocuous nature of such injuries.⁵ Only three patients died from non-intracranial injuries over the seven-year period, each undergoing extensive resuscitation. Emergency thoracotomy was carried out in the emergency department in all three cases and emergency laparotomy was performed in two patients with intra-abdominal injuries. One patient died as a result of severe injuries to the right atrium and great vessels. Two patients died as a result of intra-abdominal injuries. Both suffered from multiple entry wounds and it was unclear as to whether there was combination of intrathoracic and intra-abdominal injuries on initial examination. The first of these patients walked into the emergency department and collapsed, descending into cardiac arrest. An emergency department thoracotomy was performed immediately to gain proximal aortic control and to inspect for intrathoracic injury. No injury to the heart or great vessels was identified but return of spontaneous circulation was attained via cross-clamping of the aorta, although this would be repeatedly lost and achieved over the next 40 minutes. An emergency department laparotomy was performed and a significant liver injury was identified, alongside perforation of the stomach. The patient was almost sufficiently haemodynamically stable for transport to theatre but lost output once more, at which time it was decided to cease resuscitation. The second patient arrived by helicopter and lost cardiac output on route. An emergency department

thoracotomy was performed; blood was drained from the left chest, proximal aortic control gained and return of spontaneous circulation achieved. No cardiac or great vessel injury was identified. The patient was immediately transferred to theatre, at which point significant injury to the small bowel and transection of the left common iliac artery were identified. Damage control surgery was halted to allow for continuous damage control resuscitation in intensive care with the hope of returning to theatre, but the patient died as a result of the numerous and significant injuries to the small bowel. Both cases occurred during the transition of King’s College Hospital to a major trauma centre and several surgeons from three different subspecialties were required in theatre to address multiple, complex injuries.

Neither patient had significant intrathoracic injury but emergency department thoracotomy was justified. Protocol set out by the Eastern Association for the Surgery of Trauma recommends emergency thoracotomy for those with present or absent signs of life after penetrating extrathoracic injury. The authors do emphasise that, despite their recommendation, the available evidence is not particularly robust.²⁹ Both patients in our cohort did achieve return of spontaneous circulation post emergency thoracotomy, but the extensive nature of the injuries meant that survival was always extremely unlikely.

In the six cases in which an emergency department thoracotomy was employed, three patients survived, with surgeons successfully repairing a left ventricular laceration, an inferior vena cava defect and a superior vena cava injury. Although clearly a small patient population, these are impressive results. Seamon *et al.* appraised 250 cases of emergency thoracotomy for cardiac and great vessel injury due to single or multiple gunshot wounds and found that the chance of survival was just 2.8% and 1.4%, respectively.³⁰ In our cohort, of the four patients with penetrating cardiac or great vessel injuries, three (75.0%) survived to discharge. It is worth noting that two of these three

Table 6 Comparison of gunshot and knife injuries at King's College Hospital.		
	Gunshot injuries 2010–16 (n = 182)	Knife injuries 2011 (n = 938) ²⁶
Male (%)	98	77
Predominant age group (years)	16–24	16–24
Proportion of total emergency department admissions (%)	0.02	0.77
Proportion of trauma team workload (%)	1.5	24.0%
Multiple injuries (%)	33.5	18.9
Intra-abdominal injury following abdominal wound (%)	75.0	24.3
Admitted to hospital (%)	83.5	25.7
Direct to theatre from emergency deptment (%)	17.0	2.9
Length of hospital stay (days)	9	3
Length of hospital stay following laparotomy (days)	21	9
Mortality (%)	5.49	0.53

surviving patients also underwent laparotomies. Although intra-abdominal ($P < 0.001$) and intrathoracic ($P < 0.003$) injuries resulted in longer hospital stay among our cohort, there was no direct correlation with such injuries and mortality (Fig 7).

We believe that these improved outcomes are due to the reformation of major trauma care at King's College Hospital in 2012. A designated trauma and acute surgery department operating from the acute surgical unit is now responsible for all trauma cases and retains dual 'ownership' of the patient. The introduction of a daily multidisciplinary team trauma meeting has allowed for better continuity of care, communication and learning opportunities. A major trauma consultant, of either surgical or medical background, is a continual presence in the emergency department and a designated surgical trauma fellow with wide-ranging damage control resuscitation experience is required at the bedside of any major trauma call within five minutes of arrival. We found that patients shot in the abdomen often had extensive injuries; in 29 patients undergoing laparotomy there were 53 injuries spanning seven structures. In cases such as these, expert trauma surgeons are invaluable in providing timely and variable intervention when subspecialists often require the help of other surgeons. These results correlate well with the 2004 Cowey *et al.* study, which arrived at similar conclusions.⁵

The main strength of this study is that it provides the most comprehensive collection of data relating to gunshot victims and their injuries ever collated in the UK. Weaknesses are that this is a single-centre retrospective study and identification of patients is dependent on accurate prospective data entry. Our data represent firearm injuries presenting to the emergency department and not incident rates in the general population. Gunshot fatalities may not present to the

emergency department but may be placed immediately under the jurisdiction of the forensic pathologist. The study population is representative of South-East London's relatively socioeconomically deprived population, limiting external validity.

Conclusion

There has been a stark resurgence in gunshot injury presentations to our emergency department in 2016, in keeping with Metropolitan Police gun crime statistics. Victims continue to be disproportionately young, Black males shot in socioeconomically deprived inner-city areas surrounding King's College Hospital. Gunshot injuries place a significant burden on hospital resources and often require the expertise of multiple surgical specialties or a designated trauma surgeon with wide-ranging capabilities. The introduction of the department of trauma and acute surgery and the implementation of the major trauma network in 2010 have improved management and outcomes of gunshot injuries at South-East London's trauma hub.

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