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A B S T R A C T

Purpose: Injury records from Emergency Departments (EDs) have been studied over the last decade as part of the work of the National Violence Surveillance Network (NVSN) and provide information about local, regional and national violence levels and trends in England and Wales. The purpose of the current study is to evaluate overall, gender, age-specific and regional trends in community violence in England and Wales from an ED perspective from January 2005 to December 2009.

Methods: Violence-related injury data were collected prospectively in a stratified sample of 77 EDs (Types 1, 3 and 4) in the nine Government Office Regions in England and in Wales. All 77 EDs were recruited on the basis that they had implemented and continued to comply with the provisions of the 1998 Data Protection Act and Caldicott guidance. Attendance date, age and gender of patients who reported injury in violence were identified using assault-related attendance codes, specified at the local level. Time series statistical methods were used to detect both regional and national trends.

Results: In total 221,673 (163,384 males: 74%) violence-related attendances were identified. Overall estimated annual injury rate was 6.5 per 1000 resident population (males 9.8 and females 3.4 per 1000). Violence affecting males and females decreased significantly in England and Wales over the 5-year period, with an overall estimated annual decrease of 3% (95% CI: 1.8–4.1%, p < 0.05). Attendances decreased significantly for both genders across four out of the five age groups studied. Attendances were found to be highest during the months of May and July and lowest in February. Substantial differences in violence-related ED attendances were identified at the regional level.

Conclusions: From this ED perspective overall violence in England and Wales decreased over the period 2005–2009 but increased in East Midlands, London and South West regions. Since 2006, overall trends according to Crime Survey for England and Wales (CSEW), police and ED measures were similar, though CSEW and ED measures reflect far greater numbers of violent incidents than police data. Causes of decreases in violence in regions need to be identified and shared with regions where violence increased. © 2013 Elsevier Ltd. All rights reserved.

Introduction

In the UK the Coalition Government has prioritised the collection and use of Emergency Department (ED) derived information for violence prevention purposes [1]. Endorsed by the World Health Organisation (WHO) and previous publications by the National Violence Surveillance Network (NVSN), this harm based measure has been shown to be a reliable and objective measure that is less prone to reporting and recording biases than police measures and has, through routine collection and analysis, led to substantial and significant reductions in violence-related hospital admissions [2–4].

Although levels and trends in violence in England and Wales have traditionally been measured using the two official Home Office sources of data, the Crime Survey for England and Wales (CSEW; formerly the British Crime Survey, BCS) and police records, official statistics have often been contradictory. For example, the number of BCS violent incidents resulting in injury in 2009/2010 revealed a 29% decrease compared with the same figure in 2001 and police recorded incidents of violence against the person and its subcategory, violence against the person with injury (which includes all assault with minor injury and incidents of wounding), increased over the first half of the decade (between 2002 and 2005). However, by 2009/2010 both violence against the person and violence against the person with injury recorded by the police had fallen by 18% and 27% respectively [5].

In addition to the official publications, injury records from EDs have been studied over the last decade as part of the work of
the NVSN and provide information about local, regional and national violence levels and trends in England and Wales. The network has shown injury data to be a robust and alternative source of information on levels and trends in violence and has brought clarity to national trends by triangulating measurement. According to NVSN there were significant decreases in violence for both males and females and for all age groups studied between 1st January 2000 and 31st December 2004 (decreases of 20% in Wales and 13% in England) [6]. However, despite these decreases, the rate of violence was found to differ greatly among economic regions, with higher rates identified in the Northern regions. Regional inequalities in health and prosperity are well documented in England and Wales. Disparity in earnings, educational achievement, mortality rates, childhood obesity, lung cancer and alcohol-related harm are but a few examples that highlight the existence of such inequality [7]. It is therefore likely that violence, with its strong inequality gradient, would also be more prevalent in regions where levels of health and prosperity are low [8].

In this study, trends in violence according to ED data in England and Wales, over the 5-year period, 1st January 2005–31st December 2009 were investigated. The purpose of the study was to determine age, gender and region-specific rates of violence and violence trends and violence seasonality.

Methods

**ED departments and injury records**

Information on attendance date, age and gender of patients who reported injury in violence were collected from a stratified sample of 77 Types 1, 3 and 4 EDs (Type 1 = consultant led 24 h service with full resuscitation facilities; Type 3 = other types of ED/minor injury units; Type 4 = NHS walk-in centres) in the nine
Government Office Regions (GORs) in England (Eastern, East Midlands, London, North East, North West, South East, South West, West Midlands, Yorkshire & Humber) and in Wales over 5 years, January 1st 2005–31st December 2009 (Fig. 1). No Type 2 EDs (consultant led single specialty accident and emergency service) were successfully recruited to the study. Violence-related injury is an established category for attendance in all ED software packages and is recorded electronically by reception staff, the most appropriate staff to record such data [9]. For every new incident a new record was created and at all times during data retrieval patient confidentiality was maintained. All 77 EDs were certified members of the NVSN and were recruited on the basis that they were willing to share electronic data, had implemented and continued to comply with the provisions of the 1998 Data Protection Act and Caldercott guidance and that access to ED computer systems was restricted to a limited number of ED staff. The data is retrieved annually and has been since 1995 (see Fig. 2).

Violence-related attendance data and statistical methods

ED attendances were categorised by gender and five age groups: 0–10, 11–17, 18–30, 31–50 and 51+ years: identical categorisation to that reported in previous NSVN publications [6]. To reduce biases in the sample due to inclusion criteria used to recruit EDs, with GORs being over or under-represented, the sample population was weighted so that regional comparisons could be made. The methods used for deriving appropriate weights for individual regions have been detailed in previous publications [6]. In summary, the representation size of the sample EDs within each GOR was calculated and was termed the coverage ratio (CR);

\[
CR_i = \frac{B_i}{A_i}, \quad i = 1, 2, \ldots, 10.
\]

where \( B \) is the total regional annual attendance at EDs in the sample, \( A \) is the total annual attendance at all EDs (including Minor Injury Units and Walk-in Centres) within each GOR. Thus, a CR equal to one indicates full coverage and CR equal to zero indicates no coverage. Comparative GOR violence statistics were obtained by multiplying the number of persons injured in each region by 1/CR. As the total resident population by Government Office Region and by age is known, it was possible to stratify the regions according to the proportion of persons injured in violence [10]. A measure of the likelihood of being injured in violence within a region was given by

\[
V_i = \frac{(1/CR_i) \times n_i}{N_i},
\]

where \( V_i \) is the likelihood of being injured in violence in region \( i \), \( n_i \) is the number of injured persons attending EDs in region \( i \), and \( N_i \) is the total resident population of region \( i \). Violence injury rates (number of injured per 1000 resident population) for all ten regions were computed. This calculation was carried out for both genders and for the five age categories.

Since violence is measured by count of attendances, there were a substantial proportion of zeroes in the 0–10 years and 51 years and over age groups. A negative binomial regression model (to account for any over-dispersion) was therefore fitted using a time trend (month number) with age category, region, month and gender dummy variables. Interactions between region and time, age category and time, age category and region, gender and age category, month and age category, gender and region and gender and time were also identified. In total, there were 5880 observations from 1st January 2005 to 31st December 2009. The study did not have access to the 2009 attendance data for the West Midlands region and resulted in 120 missing observations within the sample. The violence count used as the dependent variable was, as described above, an estimate obtained by massing up the actual violence count recorded in EDs, using a coverage ratio based upon the annual attendance at EDs and attendances at all EDs in the region.

Since regional population vary with time, a log-linear regression was carried out and modelled on person-days (an exposure variable taking account of month length) from census data across the same time period. Violence rate and trend coefficients for individual regions, for example, were estimated from the ratio of these two regression models. This was done using expressions for these aggregate coefficients which are essentially weighted averages over the demographic subcategories within that region. A similar weighted averaging process was also performed over the coefficient covariance matrix for the negative binomial regression to estimate the standard errors of these aggregated coefficients. Seasonality was investigated by a similar process of aggregating over, say, region, gender, etc. to establish average rates for each month using January as the reference. More detailed methods have been published previously [6].

All data were processed in the ‘R’ statistical programming language both for collection and cleaning of the ED data as well as the model fitting [11].

Results

Violence-related injury rates

In total, there were 221,673 violence-related attendances in the 77 EDs over 5 years between 2005 and 2009. Age and gender distributions are shown in Table 1: similar to ED attendances during the previous 5 years. A quarter of attendances were of females (58,289, 26%). Those aged 18–30 years made up approximately 45% of attendances (n = 98,832). This was followed, in order, by those aged 11–17 years, 31–50 years, 51 years and over, and those aged 10 years and under.

Table 2 shows injury rates by gender by age groups and GORs. Overall in England and Wales, 6.5 per 1000 residents attended EDs annually (between 2005 and 2009) for treatment following injury in violence. Male to female ratio was three to one; 9.8 per 1000 male residents (95% CI: 7.6–10.6) and 3.4 per 1000 female residents (95% CI: 2.6–3.7). The highest injury rates were identified in the Northern regions; where the rates ranged from a low of 6.5

![Fig. 2. Trends in violence in England and Wales.](image-url)
per 1000 residents (95% CI: 4.6–9.8) in the Yorkshire and Humberside region to a high of 12.3 per 1000 residents (95% CI: 10.5–15.2) in the North West region. The lowest injury rates were identified in the Eastern region (3.9 per 1000 residents, 95% CI: 3.1–4.7).

Analyses by age group and gender showed that those aged 18–30 years had the highest injury rates per 1000 population (males 27.4, 95% CI: 21.6–29.7; females 8.6, 95% CI: 6.8–9.3) followed by those aged 11–17 years (males 17.3, 95% CI: 12.9–21.3; females 6.9, 95% CI: 5.4–8.6), those aged 31–50 years (males 9.4, 95% CI: 7.3–10.6; females 3.9, 95% CI: 3.0–4.2), those aged 51 years and over (males 1.7, 95% CI: 1.3–1.9; females 0.67, 95% CI: 0.5–0.7) and those aged 10 years and younger (males 0.65, 95% CI: 0.3–0.7; females 0.3, 95% CI: 0.2–0.4).

**National trends and seasonality**

Table 3 shows trends in violence-related attendances at EDs by gender and age groups in England and Wales over the 5-year period. Violence affecting males and females decreased substantially, with an overall estimated annual decrease of 3% (95% CI: 1.8–4.1%, p < 0.05). Violence affecting males and females aged 10 years and under, 11–17 years, 31–50 years and those aged 51 years and over decreased substantially over the study period. Violence affecting males and females aged 18–30 years did not change. Violence-related ED attendances were highest in May (7.0 per 1000 population; 95% CI: 5.7–8.0) and July (7.0 per 1000 population; 95% CI: 5.8–7.8) and lowest in February (5.6 per 1000 population; 95% CI: 4.6–6.4). There was little difference between seasonal variation of male and female ED attendances over the 5-year period. The largest rate ratio between male and female ED attendances was identified in December (3.2).

**Trends by regions**

Trends in violence related ED attendances by GOR showed significant differences between regions (Table 4). Decreases were identified in four of the English regions (Eastern, South East, North East and North West) and in Wales, with the Eastern region experiencing the most substantial decline. Comparatively, significantly increased attendances were identified in the East Midlands, London and South West regions. Yorkshire and Humberside and West Midlands regions did not experience a significant change over the study period. Age group analyses showed variability within and between GORs. Violence related attendances of those aged 0–10 years decreased in eight regions (except in Eastern and East Midlands, which showed no change). Amongst the regions which showed decreases in overall violence, almost all age groups (except those aged 0–10 years in Eastern and 18–30 years in North East) showed decreases in ED attendances over the 5 years. In Yorkshire and Humberside attendance of males and females did not change over the study period. However, age group analyses showed increases in ED attendances of those aged 18–30 years and decreases in those aged 0–17 years and 31–50 years.

**Discussion**

This national study, based on a sample of 77 EDs, stratified by ten GORs in England and Wales, showed substantial decreases in violence-related attendances of both males and females in the 5 years, 2005–2009. All age groups, except those aged 18–30 years, showed significant decreases. Previous ED based investigations on national violence trends showed that between 1995 and 2000 there was no significant change in overall violence-related attendances followed by a substantial decrease in violence-related ED attendances between 2000 and 2004 [6,12]. However, a substantial increase in attendance rates from 2004 to 2006 means that, in fact, such attendances have only decreased since 2006. This
finding is consistent with hospital admissions data for deliberate harm in England (represented by ICD codes X85 to Y09, codes for deliberate external causes) where, apart from an isolated increase in 2006/2007, the number of admissions following assault by blunt and sharp objects decreased by 11% between 2005 and 2009 [13].

This decline in violence according to hospital data is similar to trends identified from the BCS; overall BCS violence in England and Wales has been in decline since the mid 1990s [14]. When compared to BCS levels of violence in 1995, the number of violent incidents in 2010/2011 was around half (47%) and at a similar level to 1981 – this amounts to two million fewer incidents in 2010/2011 and around 750,000 fewer victims compared with the 1995 BCS. Since 1995, according to the BCS, violence with injury has fallen by 50% and violence without injury by 44%. However, inconsistent with this downward trend were a 38% increase in assault with minor injury between the 2009/2010 and 2010/2011 BCS. This may be the result of better targeted policing, for example, there is evidence to suggest CCTV surveillance directs police to incidents more quickly and more frequently, therefore allowing police to interfere and prevent assault escalating [15].

Comparison with violence trends according to police records is more difficult however. Police records tend to underestimate violence levels mainly because of lack of police ascertainment reflecting low reporting rates which in turn reflect fear of reprisals, inability to identify assailants, lack of benefit for the injured and an unwillingness to have one’s conduct scrutinised [16]. Data matching studies in other European countries have also shown consistency in the extent to which serious violence is underascertained by police services [17]. Police records have also been subject to significant changes in recording practices. For example, the introduction of NCRS in April 2002 led to a rise in recording in 2002/2003, particularly in relation to less serious violent crime in the following years, as forces continued to improve compliance with the new standard. This led to a considerable divergence in trends according to police records and both BCS violence and ED injury records – violence against the person recorded by the police increased between 2002/2003 and 2005/2006 [14]. Since 2005/2006 however, following adaptation of NCRS counting rules by police forces, violence trends have become more consistent across the three sources; numbers of offences against the person recorded by the police decreased by 22% between 2005/2006 and 2010/2011 during which period trend lines according to the three measures were similar.

Despite similarities in trends in violence in England and Wales over the last 5 years disparity in numbers of violent incidents especially according to BCS and police estimates remain. According to the 2009/2010 BCS there were 2,087,000 violent offences against adults in England and Wales [5]. This compares with 871,712 offences of violence against the person recorded by the police in the same period. Both BCS and police recorded incidents of violence can be classified according to whether or not the victim sustained any form of injury as a result of the incident. Most injuries reported to the BCS are relatively minor, such as a black eye, cuts, severe bruising and scratches. According to the 2009/2010 BCS in 17% of violent incidents the victim received some form of medical attention – an estimated 354,790 individuals [5]. Although BCS estimates do not include violent injury in children, this compares remarkably well with NVSN estimates of violence-related injury; according to ED records there were an estimated 350,010 people who attended EDs in England and Wales for treatment following violence in 2009 [18]. This also strongly suggests that most people injured in violence sought treatment in EDs rather than in primary care and provides further evidence of the objectivity of the ED measure. It is a key Government target to make primary care – GPs, opticians, dentists, pharmacists and community health services – more accessible to patients. Although the NHS Plan (2000) set a target where all patients should have the opportunity to be seen by a GP within two working days and by a primary care professional within one working day, the immediacy of treatment need following injury makes EDs more accessible to such patients compared to primary care [19]. EDs should therefore be the focus for NHS efforts to prevent violence in communities.

Although the reasons for decreases in violence nationally are not clear, there is increasing evidence to suggest that both public health and criminal justice interventions may be contributory. Information sharing partnerships between health services, police and local government have been shown to substantially reduce violent injury [3]. Implemented in all regions in England and Wales following the 1998 Crime and Disorder Act and particularly after the tackling knife crime strategy was implemented in 2008 – which placed a legal obligation on police, local government and the National Health Service to collaborate to develop and implement joint crime reduction strategies – information partnerships have altered policing and violence prevention strategies [20,21]. For example, the Cardiff Violence Prevention Programme (CVPP): a data sharing strategy that included police officials, health practitioners, and local government representatives (and later included representatives of education, transport and ambulance services, and local licensees), led to a 35% decrease in assault-related ED attendances between 2000 and 2005, as well as a 31% decrease in the prevalence of assaults occurring within licensed premises in Cardiff, relative to similar cities where this information was not shared [3]. The sharing of ED derived data for the purposes of violence prevention have also shown to be effective in the North West of England [22].

In addition, police officer strength in the 43 English and Welsh Police forces continued to increase, with an estimated increase of over 36,000 officers from 2000 to 2009 (this figures includes a further 16,800 Police Community Support Officers (PCSOS), from 2002) [23]. At the same time offenders found guilty at all courts in England and Wales for indictable offences such as violence against the person rose from 40,900 in 2005 to 43,500 in 2009 [24]. It is possible that the continued increases in police officer numbers over the last decade, coupled with the increase in convictions for violent crime over the 5 year period, may also have contributed to decreases in violence in England and Wales. Moreover, the Home Office has stated that from 1999 to 2003, £170 million of capital funding was made available for investment in CCTV development schemes as part of the then Labour Government’s Crime Reduction Programme [25]. The effects of CCTV on reducing violence in England have previously been associated with a substantial decrease in the number of people attending EDs for treatment following assault, as well as a substantial increase in violent offences recorded by the police [15]. In 2011 the Association of Chief Police Officers (ACPO) estimated the UK’s CCTV to stand at

<table>
<thead>
<tr>
<th>Government Office Region</th>
<th>% annual change in attendance</th>
</tr>
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<tbody>
<tr>
<td>Eastern</td>
<td>-12.6 (-10.3 to -14.8)**</td>
</tr>
<tr>
<td>Wales</td>
<td>-7.4 (-5.0 to 9.7)**</td>
</tr>
<tr>
<td>South East</td>
<td>-7.4 (-5.1 to 9.7)**</td>
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<tr>
<td>North West</td>
<td>-4.9 (-2.5 to -7.2)**</td>
</tr>
<tr>
<td>North East</td>
<td>-3.8 (-1.4 to -6.2)**</td>
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<tr>
<td>Yorkshire and Humberside</td>
<td>-0.8 (-3.3 to 1.7)</td>
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<tr>
<td>West Midlands</td>
<td>1.8 (-1.7 to 5.3)</td>
</tr>
<tr>
<td>London</td>
<td>3.6 (-1.1 to 6.2)**</td>
</tr>
<tr>
<td>South West</td>
<td>9.7 (7.1-12.6)**</td>
</tr>
<tr>
<td>East Midlands</td>
<td>12.1 (9.3-15.0)**</td>
</tr>
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95% confidence intervals in parenthesis.
- Significant at the 5% level.
approximately 1.85 million [26]. It is therefore also possible that increased CCTV surveillance in England and Wales over the last decade has also impacted upon the overall reduction in violence identified in this study.

In this national study all age groups except those aged 18–30 years experienced a significant decrease in violence-related ED attendances – males and females within all age groups, showed similar decreasing trends. However, age and gender-related trends masked regional differences. There were decreases in five regions, increases in three and no change in two GOR’s. The North West region and Wales continued to show decreasing violence trends over the 10 years between 2000 and 2009, surprisingly perhaps, given the concentrations of deprivation in these areas. Eastern and South East regions, following a plateau in violence over the previous 5 years, showed decreases in violence between 2005 and 2009 and violence in the North East decreased between 2005 and 2009 after increasing between 2000 and 2004. Violence in East Midlands and London increased between 2005 and 2009 despite decreasing during the previous 5 years. Surprisingly given its socioeconomic profile, the South West region showed year on year increases in violence over the 10 years, 2000–2009. Violence in Yorkshire and Humberside and West Midlands regions did not change over the study period after increasing and decreasing respectively over the previous 5 years.

Reasons for such regional variation in trends in violence are unclear, but may be multi-factorial and complex – short term trend changes are less likely to be due to changes in structural factors such as unemployment rate, poverty, inequality and more likely related to public health and criminal justice interventions at the regional level. Indeed, results from a recent audit on information sharing for the purposes of violence prevention in England, revealed that only one-third of partnerships are reaching the standard of information sharing recommended by the College of Emergency Medicine (CEM) [27]. It is therefore possible, even probable, that Regional (national in Wales) efforts to implement information sharing, where successful, may have introduced and sustained a culture of prevention to a greater extent than in other regions. In this context it is noticeable that decreases in violence did occur in health regions where ED information sharing was most developed [3,28–30]. Injury rate calculations also showed regional variations in violence rates in England and Wales.

In the previous NVSN study of violence trends, a clear pattern emerged with northern and western regions in England and Wales having the highest violent injury rates compared to regions in the south and east. Similar violent injury patterns were also demonstrated in this study. For example, north–south divides in health and prosperity are well documented, for example in relation to mortality for both sexes and among all age groups. A recent study found that the north–south disparity over the period 2000–2008 (excluding Wales) was the worst it had been for over four decades [31]. Other factors such as educational, environmental and lifestyle influences which may act over the whole life course and possibly over generations may also determine north and west regional excess in violent injury.

Overall, males and those aged 18–30 years were most at risk of sustaining violent injury; and were the only group not to experience a significant trend over the 5 years. This finding is not surprising as males and those aged 18–30 years demonstrate higher rates of delinquency, adult criminality and violent behaviour. Also, violence-related injury as a result of alcohol consumption has been found to be five times greater than any other type of injury [32]. In England and Wales, it is reported that those aged between 18 and 24 years consume, on average, more units of alcohol per session than any other age group [33]. The association between alcohol misuse and violence is well documented in epidemiology, criminology, psychology and public health literature. BCS estimates indicate an upward trend in alcohol-related violence since 1995; with 50% of violent offences, 19% of all violent incidents, and 31% of stranger violence estimated to have taken place in or around a pub or club in 2009 [5]. Visits to ED resulting from alcohol misuse cost England and Wales £645.7 million in 2006/2007 [34]. Studies in both the UK and US have however found an inverse relationship between alcohol price and violence [35,36]. A UK ED based study found that the real price of beer in England and Wales was negatively correlated with rates of violence-related ED attendances [35].

According to this study violence-related injury in England and Wales was seasonal, with highest ED attendances during the late spring and summer months of May, June, July and August – and the lowest attendances during February and November. Findings from previous NVSN publications on violence seasonality found that violence-related ED attendances peaked during summer months and in December between 2000 and 2004 [6]. Reasons for such a peak in ED violence attendances in the summer have been attributed to larger numbers of people being outdoors over a long period of time. The occurrence of major sporting events during the summer months, e.g. the football world cup has also been shown to result in increased violence-related ED attendances [35,37]. In contrast, despite festive celebrations in December, violence levels fell for both men and women during this month between 2005 and 2009 and the reasons for this, over such a sustained period, are unclear. It is possible that concentrated police and other agency effort over the Christmas/New Year period, for example, drink driving and safety campaigns, have actually reversed the traditional harm peaks of this time. However, findings from this study also reveal that the ratio of male to female violence-related ED attendances was highest in this month over the 5-year period.

Conclusion

Overall, according to all three measures, violence in England and Wales decreased over the 5-year period 2005–2009. Policy makers should, drawing on evidence from regions where violence is falling, focus violence prevention measures such as information sharing by EDs, in regions with higher violent injury rates and where violence is increasing.

Bias in ED data

This study makes three main assumptions about the data; that all those injured in violence seek treatment at EDs; that those patients declare that they have been injured in violence; and that all violence-related attendances are recorded electronically. ED data represents the most serious forms of violence, which results in injury deemed to require medical treatment and therefore does not include violence which results in minor injuries deemed not to require hospital treatment or violence which results in no injury. As proximity of the injured to an ED affects likelihood of ED attendance, violence in rural areas is likely to be underestimated [38].

Recommendations

Violence prevention efforts should be extended so that the December drink driving and safety campaigns are implemented in the period May–July.

Future research

Further research is needed to investigate and identify local factors that impact on the regional variation in current trends in violence in England and Wales.
Conflict of interest statement

The following statement confirms that there is no conflict of interest present for any of the contributing authors with regards to the article.

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