Weekend Mortality on the Continent

The cases of Germany and France

Edmund Stubbs

February 2015
Civitas: Institute for the Study of Civil Society

Edmund Stubbs is Healthcare Researcher at Civitas. He studied Biomedical Science at the University of Sheffield and has a Master's degree in Health, Population and Society from the London School of Economics and Political Science. Edmund also worked as a healthcare assistant for four years at Addenbrooke's Hospital, Cambridge and as a freelance health consultant for one year.

CIVITAS
55 Tufton Street, London SW1P 3QL
T: 020 7799 6677
E: info@civitas.org.uk

Introduction

Substantial research has been conducted in the UK regarding differences in hospital mortality rates between those occurring on weekdays and at the weekend. A study conducted in 2012 of over 14 million admissions to English NHS hospitals found that patients admitted on Sundays had a 16% higher probability of death compared to those admitted on Wednesdays.[1] There are many possible reasons for this; for example the researchers speculated that although lower staffing levels at the weekend could have an effect, people who have more urgent needs, those who cannot wait to see a doctor on Monday, are admitted more frequently at the weekend.[2] Emergency surgery, with possibly more dangerous outcomes, is therefore more commonly carried out at the weekend than on weekdays.[3] A smaller study of 4 million admissions carried out in 2010 similarly found a 10% higher mortality rate at weekends[4] and the journal *Dr Foster Intelligence* has discovered that the carrying out of essential diagnostic procedures is less common at the weekend. Such procedures include emergency endoscopies (40% lower) and the fixing of fractures (10% lower). Additionally *Dr Foster* found a 24% higher mortality rate in patients undergoing routine surgery on Fridays than on other week days.[5] This might suggest that staff supervision of patients and perhaps even concentration and attention diminish as the weekend approaches, another factor determining higher weekend mortality rates.

Taken together, this evidence might support the claim that staffing issues, rather than severity of illness could be the most significant contributor to the weekend effect. In a separate report, *Dr Foster* claimed to have identified a 'clear association' between reduced numbers of senior doctors working at the weekend and increased mortality.[6] In England, lower clinical staffing levels in hospitals during the night and at the weekend is well documented.[7] Emergency departments only manage to have a consultant presence available during 12 hours of each day for 30% of the time at weekends as compared to 77% during weekdays (see figure 1).[8] A further study, investigating staffing levels in England perhaps significantly concluded that it was rather the ratio of nurses to patients that determined the probability of mortality (with regard to stroke patients) than the presence (or absence) of doctors on all 7 days of the week.[9] Comprehensive handovers on Friday evenings are also identified as being particularly important for staff to care effectively for patients over the weekend, with large decreases in weekend mortality recorded after the content of such handovers was enhanced.[10] NHS England has officially voiced concern over lower staffing levels at weekends,

stating that 'reduced service provision, including fewer consultants working at weekends, is associated with England's higher weekend mortality rate.'[11] It concludes that it is necessary to have consistent levels of service availability on all days to remedy this problem.[12] As an example, London's heart attack facilities currently operate a consultant-delivered service on all 7 days of the week with no observed differences in mortality between the week and weekend being observed.[13]

It should not however be overlooked that some studies have found no difference between mortality on week days and at weekends in the UK. One such, albeit with a sample size of only 6749 patients and specific to upper-gastrointestinal bleeding problems, found no differences in mortality rates at the weekend from those during the week.[14]

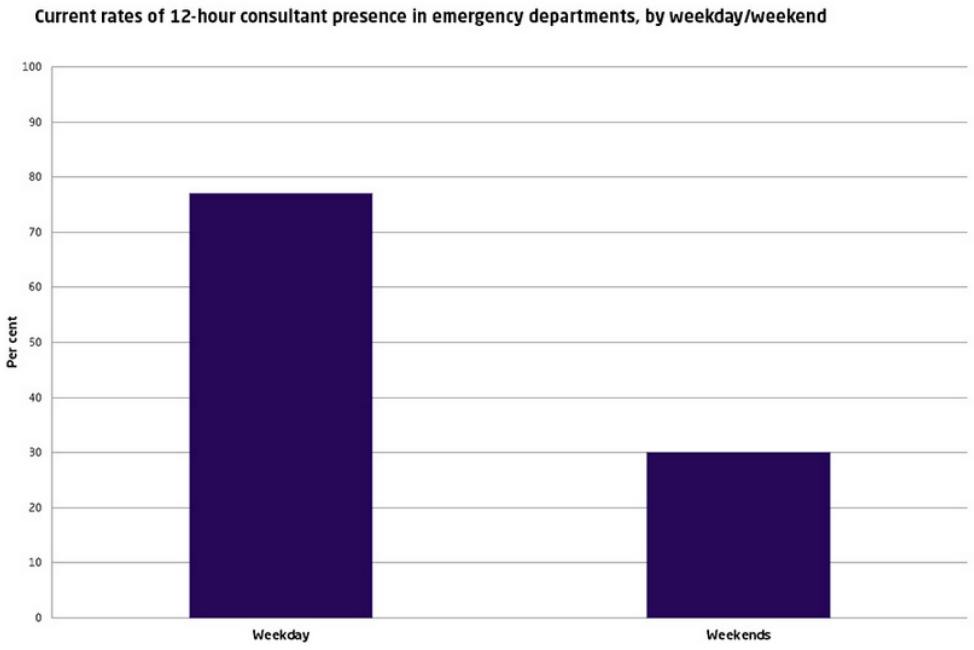

Figure 1. 2014 rates of 12 hour consultant presence in A&Es Weekends vs weekdays[15]

A multitude of studies have also been undertaken in the USA. An extremely large study of 48,253,968 hospital discharges found a 15% higher mortality risk following weekend admission.[16] Mortality was also worse in hospitals with fewer nurses and physicians on duty at weekends. These findings led to the conclusion that staffing levels evidently impact weekend mortality.[17] More specific studies undertaken

amongst pulmonary embolism patients[18] and stroke patients[19] (amongst others) further seemed to indicate markedly higher mortality rates at weekends in the USA. Australia and Canada have also published a large volume of research on weekend mortality with similar conclusions.

This report aims to investigate if mortality is higher at weekends in two of Britain's close neighbours: Germany and France, and discusses those characteristics of their health systems that could potentially effect (by reducing or exacerbating) morality rates at different times of the week.

The German healthcare system

The UK currently has 64.1 million inhabitants,[20] with 18.1% of its population aged over 65, and set to increase to 20% by 2025.[21] Germany has a more rapidly increasing proportion of elderly population than does the UK. In Germany, the 'dependency ratio' is set to increase from the present 26.5 people aged over 65 per 100 working age citizens, to 39.3 in 2025.[22] Germany's larger population of 81.3 million[23] currently has around 21.4% of its population aged over 65, a proportion set to increase to that of over a quarter of all citizens by 2025.[24]

Insurance

German citizens are covered by a series of statutory sickness funds, collectively described as Germany's social health insurance (SHI) system or Gesetzliche Krankenversicherung (GKV). All working citizens must pay 15.5% of their earnings into one of these sickness funds, with employers making contributions of similar value on their employees' behalf.[25] The dependents of contributing citizens are covered without further charge while vulnerable and impoverished groups receive government subsidies.[26] Those earning over €52,000 per year have the option to leave SHI and pay for health care privately. However, at present, only around 25% of this group do so.[27]

After substantial reform in 2009, Germany established a central health fund which pools the €167 billion generated from mandatory SHI premium payments in order to redistribute it between 150 individual sickness funds according to these funds' calculated requirements as indicated by risk equalisation formulae.[28] Members are able to switch between sickness funds on an annual basis if they so wish. Post 2009, it is also now much easier for privately insured individuals to switch between schemes as they can now transfer accumulated 'ageing provisions' (subsidies on premiums in old age accumulated in youth) between competing insurers.[29]

Provision

In Germany outpatient treatment is commonly conducted away from acute hospitals by primary care physicians, with many 'specialist practices' existing in each town or city.[30] Roughly half of all hospital beds are provided by public sector hospitals, around a third by non-for-profit private hospitals, with profit-making private sector providers making up the remainder.[31] Each individual has the right to choose which GPs, specialists and hospital services they wish to use, with insurance funds reimbursing them on a uniform fee per service category basis.[32] German patients are often discharged at weekends, and thus it is common to see lower bed occupancy rates then than on week days.[33]

German hospital mortality rates

Germany has conducted a fair body of research concerning weekend mortality in hospitals. The most prominent study was that undertaken at the Charité hospital in Berlin. The researching team found that hospital mortality after surgery varies according to time of day, day of the week and month of the year.[34] They analysed the cases of 218,758 patients, discovering that surgery conducted at the weekend was associated with a 22% increased chance of death as compared with surgery undertaken on a week day. Surgery in the afternoons was also more risky (21% increase) as was surgery in February (16% above the average for the entire year).[35] Once again it must be recognised that although outcomes *might* be influenced by the standard of care, they could also be influenced by the severity of illness patients experience at these times of the day, week and year. The study's authors however, consciously controlled for risk factors such as emergency surgery in the presentation of their results.

A separate study of 72 German hospitals similarly found higher in-hospital mortality amongst those patients admitted at weekends and this was equally the case for those undergoing both elective and non-elective surgery.[36] Cases of 'rushed' or premature discharge were also observed, with increased numbers of patients who had been discharged at weekends being subsequently readmitted as emergencies.[37] However, a seemingly contradictory third study of 916,000 patients, selected from a range of German hospitals, published completely opposite results. Here, even though Friday discharges were possibly being 'rushed' leading to readmission, more mortality was recorded as occurring during the week than at weekends.[38] Nevertheless, a statistical survey comparing all German hospitals concluded that the results from its regression models were 'inconclusive' as regards a weekend effect on mortality, with no coefficients being statically

significant.[39] However, it stated that on occasions when bed occupancy was suddenly raised at weekends, compared to week days, a statistically significant higher mortality rate was recorded. This phenomenon could have been due to hospitals being less prepared to handle sudden increases in patient volume, possibly due to lower staff numbers, or from less senior nurses and doctors being on duty at that time.

With regard to studies of specific patient groups, a study monitoring the administration of thrombolytic therapy (thrombolysis) within 4.5 hours of stroke onset showed no difference in mortality rates at weekends and weekday nights than during weekdays.[40] By contrast, a second study of 37,396 stroke patients recorded higher mortality rates at weekends and at nights than on weekdays. Importantly however, after adjusting for case severity (weekend and night cases were, on average, in a more severe clinical condition), there appeared to be no relationship between day of admission and risk of death.[41] In fact rates of thrombolytic treatment were higher in out-of-hours periods, possibly reflecting the greater severity of cases at those times. A study at Munich University Hospital conducted in relation to myocardial infarctions measuring each patient's 'door to balloon' time (time from emergency department entry to insertion and positioning of arterial catheter) found that although there was no significant difference between individual days of the week; at weekends, there was a slightly longer than average 'door to balloon' period, and patients admitted then could expect a slightly longer stay in hospital.[42] Longer delays before treatment completion and extended stays in hospital can both indicate a poorer overall level of care, however, as with earlier examples, it must be remembered that, lacking an alternative, serious cases may require emergency intervention at weekends and thus influence outcome. Tellingly, a study of the Berlin myocardial infarction registry revealed that although there was no outcome difference between common types of infarction, with rarer forms, higher mortality was recorded at weekends and at night.[43] Again, this could have been caused by less senior consultants and nurses being present out of 'normal' hours and those junior staff on duty being less able to identify and treat rarer cases. Once again staffing issues are proposed as being a significant factor in the increased weekend mortality rate.

It may also be significant that that poorer weekend mortality rates have also been recorded in German palliative care services operating independently of hospitals. In an analysis of 2565 patients mortality rates on weekends and public holidays were found to be 18% higher than on normal working days.[44]

German staffing levels

A 2007 study undertaken by the University of Cologne (Universität zu Köln) to assess the quality of care in German hospitals found it 'impossible' to construct any realistic model of staff to patient ratios. This was due to a lack of available information about schedules for nurses and doctors.[45] However, the researchers presumed that in Germany there is no reduced staffing during weekends in hospitals.[46] Information requests addressed to German hospitals by the authors of this report revealed that there was no consensus concerning normal or expected staffing levels at weekends. There was also a lack of statistical data concerning German physicians working at weekends in both the acute and ambulatory sectors.[47]

French healthcare system

At 66.2 million[48] France has a slightly smaller population than that of Germany. Currently, 18.7% of France's population is aged over 65, and this is set to increase to 21.7% by 2025.[49] These figures represent a smaller proportion of elderly people in relation to overall population than is the case in Germany.

Insurance

France has a national health insurance (NHI) system which covers a large proportion of treatment costs for most conditions. However, sizeable out-of-pocket copayments are often still required to be made by patients. This fact has encouraged the growth of a private, voluntary insurance sector which reimburses health service users for these extra payments. Over 90% of the French population has joined one of these voluntary schemes.[50] The bulk of such extra NHI cover is provided by the Caisse Nationale d'Assurance Maladie des Travailleurs Salariés (CNAMTS) (for almost 90% of the population). Other smaller schemes cater for specialised groups such as agricultural works or self-employed citizens.[51] Overall, 60% of NHI revenue is generated from payroll taxes, and 40% from a proportional income tax.[52]

Provision

Around three quarters of French hospital beds are provided by public or not-for-profit providers, whereas outpatient providers are mostly based in the private sector.[53] France has the largest commercial healthcare sector in Europe.[54] A prominent characteristic of the French system is the substantial amount of choice that French citizens have over which providers to use. A patient can select any

certified provider for primary, outpatient or inpatient care.[55] Hospitals are financed according to payments calculated in accordance with 'diagnosis related groups' (DRGs). Private hospitals charge for doctors' fees and thus receive smaller DRG payments than State and not-for-profit hospitals.[56]

French mortality rates

Research on French mortality is somewhat more limited than is German. The most prominent French study on weekend mortality was conducted in Dijon and concerned the prognosis following stroke and milder transient ischemic attacks (TIAs). Here it was discovered that higher rates of mortality were associated with weekends and bank holidays between 1985 and 2003, but not between 2004 and 2010.[57] This fall in weekend mortality followed the establishment of a 24/7 dedicated stroke care network around the city of Dijon in 2004.[58] Separate research has also been undertaken in French intensive care units (ICU's). One study found that hospital admissions at weekends or during the night *to* ICUs were not associated with any increased risk of death, but those discharged *from* the ICU to normal wards at these times did indeed have an increased risk of mortality.[59] The researchers noted that in most participating ICUs, weekend and night discharges were discouraged, however, ICUs might be forced to discharge a patient at these times if a more acutely ill patient needed an ICU bed.[60] Hence the reason for subsequent mortality amongst these discharged patients might be due to lack of sufficient post-operative care rather to any difference in staffing at weekends or at night. These patients would, on average, leave ICU units in a worse clinical condition if discharged to a normal ward at the weekend rather than on a week day. A second study reinforced these findings. In it, in-hospital mortality was not found to be higher for 'out of normal-hours' admissions than for weekday admissions.[61]

With specific regard to emergency care, a French study on upper gastrointestinal bleeding cases found that the mean time from admittance to endoscopy was actually shortest during weekends, with consequently no higher mortality rate observed.[62] It is worth noting however that an on-call 'gastrointestinal senior' was available at weekends in nearly all hospitals studied,[63] suggesting that such staffing arrangements ensured that care was equally good on all days of the week. Conversely however, results from another French study on another emergency procedure, percutaneous coronary intervention (PCI), showed that death at night-time and at weekends following PCI were higher than on week days.[64] Unfortunately information on staffing was not available in this case.

A lack of available national-level statistical data has been cited by some as being prominent reason why so little is known in France about differences between week day and weekend mortality.[65] France maintains strict laws restricting access to patient information. For example it only became possible for researchers to access 'date of mortality' data on the national level in 2008.[66] Often, French surveys are carried out in specialised settings, for example in specific departments, or in relation to specific illnesses, such as stroke. France lacks any published large scale, general studies, making the weekend effect in its hospitals hard to either affirm or deny.

French staffing levels

In 2002, French doctors went on strike protesting against the requirement that they provide out of hours services, they now do so on an entirely voluntary basis as a part of their GP services.[67] This fact might serve as an indication of the independent nature of many French health care professionals. When requested to provide information for the present study, most French hospitals were either unable or perhaps even unwilling to provide staffing data for weekdays or weekends. This may be partly due to the competitive nature of the French healthcare system which discourages homogeneity between providers and tries to maintain the public prestige of particular institutions.

Discussion

The available studies from Germany and France analyse smaller numbers of outcomes than do British studies. This is possibly the result of German and French hospitals generally not forming part of one umbrella organisation, as is the case in Britain with its NHS hospitals. Researchers in the UK can, with reasonable ease, obtain data for all NHS hospitals and thus utilise its more generic statistics to generate large sample groups (such as one exemplary study of 14 million admissions to English NHS hospitals). Obviously a large sample size in a survey appears to lend validity to its conclusions, as is the case with studies based on general patient populations rather than disease specific groups. Many studies, including those conducted in the UK, investigated weekend mortality for specific disease groups or within specific hospital departments. Research of this nature can prove extremely useful for clinicians wishing to improve services in the departments concerned (for example in the case of percutaneous coronary intervention which has enabled physicians to make better informed choices

regarding the discharge of patients). However, these studies are of limited use in assessing whether or not a general weekend effect occurs in a nation's hospitals. When the conclusions of broad studies are available, relating to all disease groups in a hospital, it can be ascertained whether or not there is an overall weekend effect on mortality (either the result of presenting at hospital in a worse condition than on week days or from receiving poorer quality weekend treatment). With regard to specific disease mortality, it would appear that the appointment of even, for instance, a single weekend cardiac consultant could completely transform weekend mortality rates in a cardiovascular centre. Nevertheless, such an appointment would do little to change any heightened mortality rate due to lesser numbers of nursing or technical staff on duty, for example putting vital diagnostic equipment such as MRI scanners out of commission at weekends, sometimes to the detriment of a whole group of hospitals. Another complicating factor is that many available studies collect general data for ‘off-hours’ or ‘out-of-hours services’ which sometimes bundles the mortality statistics for nights and weekends together. Subsequently any possible weekend effect is harder to identify.

Disease and department-specific studies are likely to be the reason for heterogeneity in the available French and German statistics for weekend mortality, with some such studies reporting higher, some unchanged and some favourable levels compared to those of week days. Where large scale studies have collected data on entire patient groups, unspecific to disease or hospital department, the statistics are more consistent, and it is on these that any tentative conclusions should be based. Of Germany France and Britain, Britain has undertaken the largest collaborative study of the outcomes from 14 million hospital admissions mentioned earlier; contributing strong evidence for increased hospital mortality at weekends. Germany’s Charité hospital study of the outcomes of over 200,000 surgical patients adds weight to this conclusion as does the research undertaken in 72 German hospitals, which reported higher weekend mortality for both elective and non-elective surgery patients.

The previously cited large study of over 900,000 hospital treatment outcomes conducted in Germany (non-specific for department or ailment) surprisingly revealed that it was safer for patients to be discharged at weekends rather than on week days. It would appear therefore that ward procedures (in this case the discharging of patients) were being carried out more competently at this time than on weekdays, possibly countering the argument that services and competent staffing are generally worse at weekends. However, this phenomenon might simply

be due to the wards being then less busy. It seems obvious that a procedure such as correctly discharging a patient is much less demanding than correctly treating an emergency patient who has presented with a severe condition. The disadvantage of having less senior nurses and consultants on duty at weekends (and thus probably less safe care) may not be reflected in the ability of available staff to competently discharge patients! By contrast, the German study on general admissions which found that sudden rises in bed occupancy lead to much more dangerous outcomes at weekends than week days seems to indicate that reduced staff numbers, or the presence of less experienced staff at the weekend are factors definitely detrimental to patient welfare.

From the foregoing it can be deduced that if the results of the more limited studies on specific departments or wards are discounted, taking into consideration only broad research, in the case of Germany, that there is indeed a weekend effect on patient mortality. There are also substantial indications that this phenomenon could be linked to staffing issues, however, limited available data on staffing prevents definite conclusions being reached.

When the French situation is considered, only a fragmented and heterogeneous body of research data is available. All outcome studies accessible in France investigate specific illnesses or hospital departments and thus it would be unwise to conclude from them the existence or absence of a weekend effect on patient mortality in that country. The French healthcare system gives great importance to the notion of patient choice.[68] As a consequence French hospitals are in constant competition with each other and other providers, making them much less willing to disclose information that could in any way damage their reputation. At the same time strict patient data protection laws restrict research by making it hard to collect required information at the national level. For example patient information can only be obtained by submitting both a patient's 'carte vital' and a doctor's 'carte professionnel de Santé' to the same source.[69] French citizens are also protected by the Commission Nationale de l'Information et des Libertés which defends their right to keep their personal data private.[70] When requesting information from French hospitals on staffing and weekend mortality for this report, French hospital staff were generally a lot less forthcoming than their German counterparts to disclose any relevant information. This, as stated earlier, could be due to concerns for their hospital's reputation, as patients who hear bad reports can simply 'vote with their feet' and seek treatment elsewhere.

Another factor of influence on coming to any conclusion is what actually might be meant by the 'weekend'. Many studies classified any admittance after midnight on Friday and before midnight on Sunday as occurring during the 'weekend'. However studies classifying 'out-of-hours' care might have different understandings of what constitutes 'out of hours', for example, from what time in the evening (6pm, 8pm or 10pm) would 'night-time' or 'out-of-hours' services begin?

In conclusion, it seems highly likely that mortality *is* affected negatively in German hospitals during the weekend; as it almost certainly is in England. The two most prominent possible causes have been discussed.

A) Due to overall staff, or experienced staff levels being reduced at weekends.

B) Because of patients, more crucially ill, presenting to hospital at the weekend.

Given the large body of evidence substantiating the weekend effect in so many countries around the world, and the considerable supporting data from America, where providers are highly competitive and patient choice is comprehensive, it seems plausible to suggest that a weekend-effect probably also exists in France. However, a more transparent administrative system with available national-level data on both staffing and mortality will be needed to determine if this is indeed the case, and further, to determine the causes of this phenomenon.

References

[1] Freemantle, N., & etal. (2012). Weekend hospitalisation and additional risk of death: An analysis of inpatient data. *J R Soc Med, 105*(2), 74-84. Retrieved from http://jrs.sagepub.com/content/105/2/74.short

[2] Freemantle, N., & etal. (2012). Weekend hospitalisation and additional risk of death: An analysis of inpatient data (See above)

[3] Grant, S., Hickley, G., Taggart, D., Roxburgh, J., Cooper, G., & Bridgewater, B. (2012). Re: Higher senior staffing levels at weekends and reduced mortality. *BMJ,* p. 344:e367. Retrieved from http://www.bmj.com/content/344/bmj.e67/rr/575993

[4] Aylin, P., Yunus, A., Bottle, A., & Bell, D. (2010). Weekend mortality for emergency admissions. A large, multicentre study. *Qual Saf Health Care, 19*, 213-217. Retrieved from http://qualitysafety.bmj.com/content/19/3/213.short

[5] Strengthen your Weekend. (2015). Dr Foster Intelligence. Retrieved fromhttp://myhospitalguide.drfosterintelligence.co.uk/#/weekend-care

[6] Reducing mortality at night and weekends. (2010). Dr Foster Health. Retrieved fromhttp://www.drfosterhealth.co.uk/

[7] Goddard, A., Hodgson, H., & Newberry, N. (2010). Impact of the EWTD on patient:doctor ratios and working practices for junior doctors England and Wales 2009. *Clin Med,* pp. 330-335. Retrieved from http://www.clinmed.rcpjournal.org/cgi/pmidlookup?view=long&pmid=20849004

[8] Emergency Medicine Consultants: Workforce Recommendations (2010). Royal College of Emergency Medicine. Retrieved from http://secure.collemergencymed.ac.uk/code/document.asp?ID=5324

[9] Bray, B. Ayis, S. Campbell, J. Geoffrey C. James, M. Hoffman, A. Tyrrell, P. Charles, A. Wolfe, A. Rudd, A. (2014). Associations between Stroke Mortality and Weekend Working by Stoke Specialist Physicians and Registered Nurses: Prospective Multicentre Cohort Study. PLOS Medicine. Retrieved from http://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1001705

[10] Patel, R. & Thiagara. (2014). Sturctured approach in improved weekend handovers in a medical high dependency unit. *BMJ Qual Improv Report.* **3**. Retrieved from http://qir.bmj.com/content/3/1/u205194.w2142.full

[11] Urgent and Emergency Care Review Team. (2013). High quality care for all, now and for future generations: Transforming urgent and emergency care services in England. NHS England. Retrieved from http://www.england.nhs.uk/wp-content/uploads/2013/06/urg-emerg-care-ev-bse.pdf

[12] Urgent and Emergency Care Review Team. (2013). High quality care for all, now and for future generations: Transforming urgent and emergency care services in England. (see earlier)

[13] Acute emergency and maternity services. (2015). NHS London Health Porgrammes Wesbite. Retrieved from http://www.londonhp.nhs.uk/services/quality-and-safety-programme/ (19/01/15)

[14] Jairath, V., Kahan, B., Logan, R., Hearnshaw, A., Murphy, M., & Palmer, K. (2011). Mortality From Acute Upper Gastrointestinal Bleeding in the United Kingdom: Does It Display a 'Weekend Effect'? *Am J Gastroenterol, 106*, 1621-1628. Retrieved from http://www.nature.com/ajg/journal/v106/n9/abs/ajg2011172a.html

[15] Urgent and emergency care mythbusters. (2014). The King's Fund Webpage. Retrieved from http://www.kingsfund.org.uk/projects/urgent-emergency-care/urgent-and-emergency-care-mythbusters

[16] Ricciardi, R. Nelson, J. Roberts, P. Marcello, P. Read, T. Schoetz, D. (2014). Is the presence of medical trainees associated with increased mortality with weekend admission? BMC Med Educ. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3926858/

[17] Ricciardi, R. Nelson, J. Roberts, P. Marcello, P. Read, T. Schoetz, D. (2014). Is the presence of medical trainees associated with increased mortality with weekend admission? BMC Med Educ.(see earlier)

[18] Aujesky, D. Jimenez, D. Mor, M. Geng, M. Fine, M. Ibrahim, S. (2009). Weekend versus weekday admission and mortality following acute pulmonary embolism. National Institute of Health. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2746886/

[19] Reeves, M. Smith, E. Fonarow, G. Hernandez, A. Pan, W. Schwann, L. (2009). Off-hour admission and in-hospital stroke case fatality in the get with the guidelines stroke program. *Stroke.* **40**:596-576. Retrieved from http://stroke.ahajournals.org/content/40/2/569.full.pdf+html

[20] Population, Total. (2014). The World Bank. Retrieved from http://data.worldbank.org/indicator/SP.POP.TOTL

[21] World Population Prospects: The 2012 Revision. (2012). United Nations: Dept of Economic and Social Affairs. Retrieved from http://esa.un.org/wpp/unpp/panel_indicators.htm

[22] The World Factbook: Germany. (2015). Central Intelligence Agency. Retrieved from https://www.cia.gov/library/publications/the-world-factbook/geos/gm.html

[23] Population, Total. (2014). The World Bank (see earlier)

[24] World Population Prospects: The 2012 Revision. (2012). United Nations: Dept of Economic and Social Affairs. (see earlier)

[25] Bidgood, E., & Clarke, E. (2013). Health Systems: Germany. Civitas. Retrieved from http://www.civitas.org.uk/nhs/download/germany.pdf

[26] Stolpe, M. (2011). Public Health Care Reforms: The German Experience. IMF Conferenece. Retrieved from http://www.imf.org/external/np/seminars/eng/2011/paris/pdf/stolpe.pdf

[27] Blumel, M. (2013). International Profiles of Healthcare Systems, 2013: The German Healthcare System. The Commonwealth Fund. Retrieved from http://www.commonwealthfund.org/~/media/files/publications/fund-report/2013/nov/1717_thomson_intl_profiles_hlt_care_sys_2013_v2.pdf

[28] Stolpe, M. (2011). Public Health Care Reforms: The German Experience (see earlier)

[29] Pallot, P. (2011). Expat Guide to Germany: health care. The Telegraph. Retrieved from http://www.telegraph.co.uk/health/expathealth/8572290/Expat-guide-to-Germany-health-care.html

[30] Bidgood, E., & Clarke, E. (2013). Health Systems: Germany (see earlier)

[31] Blumel, M. (2013). International Profiles of Healthcare Systems, 2013: The German Healthcare System (see earlier)

[32] Blumel, M. (2013). International Profiles of Healthcare Systems, 2013: The German Healthcare System (see earlier)

[33] Mennicken, R. (2007). Capacity Utlisation and Quality of Care in German Hospitals. Working Papers on Healthcare Management, Universität zu Köln. Retrieved from http://www.econbiz.de/archiv/k/uk/sgesundheit/capacity_quality_care_.pdf

[34] Spies, C. (2014). Risk of death highest following surgery in afternoons, at weekends, and in February. Public Release, European Society of Anaesthesiology. Retrieved from http://www.eurekalert.org/pub_releases/2014-05/eso-rod052914.php

[35] Spies, C. (2014). Risk of death highest following surgery in afternoons, at weekends, and in February. Public Release, European Society of Anaesthesiology (see earlier)

[36] Schwierz, C. Augurzky, B. Wasem, J. (2009). Does the Quality of Hospital Treatment Vary by Days of the Week? Ruhr Economic Papers. Retrieved from http://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID1488015_code343237.pdf?abstractid=1488015&mirid=1

[37] Schwierz, C. Augurzky, B. Wasem, J. (2009). Does the Quality of Hospital Treatment Vary by Days of the Week? Ruhr Economic Papers.(see earlier).

[38] Nussler, N. Schmidt-Schonthal, C. Nussler, A. Langrehr, J. Kaiser, U. Neuhaus, P. Lohmann, R. (2006). Mehr Wiederaufnahmen nach Krankenhausentlassung am Freitag. *Dtsch Arztebl.* **103**(14). Retrieved from http://www.aerzteblatt.de/archiv/50881/Mehr-Wiederaufnahmen-nach-Krankenhausentlassung-am-Freitag

[39] Mennicken, R. (2007). Capacity Utlisation and Quality of Care in German Hospitals. Working Papers on Healthcare Management, Universität zu Köln. (see earlier)

[40] Georg-Hausler, K. Gerischer, L. Vatankah, B. Audebert, H. Holte, C. (2011). Impact of Hospital Admission During Nonworking Hours on Patient Outcomes After Thrombolysis for Stroke. *Stroke*. **42**:2521-2525. Retrieved from http://stroke.ahajournals.org/content/42/9/2521.full.pdf

[41] Jauss, M. Oertel, W. Allendoerfer, J. Misselwitz, B. Hamer, H. (2009). Bias in request for medical care and impact on outcome during the office and non-office hours in stroke patients. European Journal of Neurology. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/j.1468-1331.2009.02656.x/pdf

[42] Mittenzwei, S. Steinbeck, G. (2010). Analyse der präklinischen und klinischen Versorgung des akuten ST-HebungsInfarktesals Grundlage einer strukturoptimierten Patientenversorgung und Implementierung eines Infarktregisters am Klinikum der Universität München, Campus Großhadern. Universität München. Retrieved from http://edoc.ub.uni-muenchen.de/11053/2/Mittenzwei_Simon.pdf

[43] Maier, B. Rohnisch, J-U. Behrens, S. Graf-Bothe, C. Kuckuck, H. Schoeller, R. Schuhlen, H. Theres, H. (2008). Einfluss des Aufnahmezeitpunkts im Krankenhaus auf Behandlung un Outcome von Patienten mit ST-Hebungsinfarkt: Daten des Berliner Herzinfarktregisters. Berliner Herzinfarkregister. Retrieved from http://www.herzinfarktregister.de/fakten/2008/dgsmp08_poster_arbeitszeit.pdf

[44] Voltz, R. Kamps, R. Greinwald, R. Hellmich, M. Hmacher, S. Becker, G. Kuhr, K. Gaertner, J. (2014). Silent night: retrospective database study assessing possilbity of 'weekend effect' in palliative care. *BMJ.* **349**:g7370. Retrieved from http://www.bmj.com/content/349/bmj.g7370.full.pdf+html

[45] Mennicken, R. (2007). Capacity Utlisation and Quality of Care in German Hospitals. Working Papers on Healthcare Management, Universität zu Köln. (see earlier)

[46] Mennicken, R. (2007). Capacity Utlisation and Quality of Care in German Hospitals. Working Papers on Healthcare Management, Universität zu Köln.(see earlier)

[47] Mennicken, R. (2007). Capacity Utlisation and Quality of Care in German Hospitals. Working Papers on Healthcare Management, Universität zu Köln.(see earlier)

[48] Population, Total. (2014). *The World Bank* (see earlier)

[49] World Population Prospects: The 2012 Revision. (2012). United Nations: Dept of Economic and Social Affairs. (see earlier)

[50] Bidgood, E., & Clarke, E. (2013b). Healthcare Systems: France. Civitas. Retrieved from http://www.civitas.org.uk/nhs/download/france.pdf

[51] Chevreul, K., Durand-Zaleski, I., Bahrami, S., Hernandez-Quevedo, C., & Mladovsky, P. (2010). France: Health System Review. *Health Systems in Transition, European Observatory on Health Systems and Policies, 12*(6). Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0008/135809/E94856.pdf

[52] Le Pen, C. (2009). The French Healthcare System. International Society for Pharmacoeconomics and Outcomes Research (ISPOR). Retrieved from http://www.ispor.org/news/articles/November09/tfhcs.asp

[53] Durand-Zaleski, I. (2013). International Profiles of Health Care Systems, 2013: The French Health Care System. The Commonwealth Fund. Retrieved from http://www.commonwealthfund.org/~/media/files/publications/fund-report/2013/nov/1717_thomson_intl_profiles_hlt_care_sys_2013_v2.pdf

[54] Le Pen, C. (2009). The French Healthcare System (see earlier)

[55] Bidgood, E., & Clarke, E. (2013b). Healthcare Systems: France (see earlier)

[56] Le Pen, C. (2009). The French Healthcare System (see earlier)

[57] Bejot, Y. Abba-Eboule, C. Jacquin, A. Troisgross, O. Hervieu, M. Durier, J. Osseby, G. Giroud, M. (2013). Stroke care organisation overcomes the deleterious 'weekend effect' on 1-month stroke mortality: a population based study. *European Jounral of Neurology.* **20**(8) pp1177-1183. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/ene.12154/abstract;jsessionid=CA62FB02E6224ADFCE50431E992B3221.f02t04?deniedAccessCustomisedMessage=&userIsAuthenticated=false

[58] Bejot, Y. Abba-Eboule, C. Jacquin, A. Troisgross, O. Hervieu, M. Durier, J. Osseby, G. Giroud, M. (2013). Stroke care organisation overcomes the deleterious 'weekend effect' on 1-month stroke mortality: a population based study. European Jounral of Neurology. (see earlier)

[59] Laupland, K. Misset, B. Souweine, B. Tabah, A. Azoulay, E. Goldgran-Toledano, D. Dumenil, A-S. Vesin, A. Jamali, S. Kallel, H. Clec'h, C. Darmon, M. Schwebel, C. Timsit, J-F. (2011). Mortality associated with timing of admission to and discharge from ICU:a

retrospective cohort study. *BMC Health Services Research.* **11**(321). Retrieved from http://www.biomedcentral.com/1472-6963/11/321/

[60] Laupland, K. Misset, B. Souweine, B. Tabah, A. Azoulay, E. Goldgran-Toledano, D. Dumenil, A-S. Vesin, A. Jamali, S. Kallel, H. Clec'h, C. Darmon, M. Schwebel, C. Timsit, J-F. (2011). Mortality associated with timing of admission to and discharge from ICU:a retrospective cohort study. BMC Health Services Research. (see earlier)

[61] Luyt, C. Combes, A. Aegerter, P. Guidet, B. Trouillet, J. Gibert, C. Chastre, J. (2007). Mortality among patients admitted to intensive care units during weekday day shift compared to 'off' hours. *Crit Care Med.* **35**(1) pp3-11. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/17080000?dopt=Abstract

[62] Nahon, S. Partiente, A. Latrive, J-P. (2009). Weekend admission does not influence the mortality of upper gastrointestinal bleeding caused by peptic ulcers: results of a French prospective study of the association nationale des gastroenterologues des hopitaux generaux group. *Clinical Gastroenterology and Hepatology.* **7**(8) p911. Retrieved from http://www.cghjournal.org/article/S1542-3565(09)00263-8/fulltext

[63] Nahon, S. Partiente, A. Latrive, J-P. (2009). Weekend admission does not influence the mortality of upper gastrointestinal bleeding caused by peptic ulcers: results of a French prospective study of the association nationale des gastroenterologues des hopitaux generaux group. Clinical Gastroenterology and Hepatology. (see earlier)

[64] Lairez, O. Roncalli, J. Carrie, D. Elbaz, M. Galinier, M. Tauzin, S. Celse, D. Puel, J. Fauvel, J-M. Ruidavets, J-B. Reltationship between time of day, day of week and in-hospital mortality in patients undergoing emergency percutaneous coronary intervention. Elselvier, Archives of Cardiovascular Diseases. Retrieved from http://www.sciencedirect.com/science/article/pii/S1875213609002526

[65] Leclerc-Imhoff, F. (2013). Surmortalité à l'hôpital le week-end : pourquoi il n'y a pas (encore) d'étude en France. L'OBS AVEC Rue 89. Retrieved from http://rue89.nouvelobs.com/2013/09/27/surmortalite-a-lhopital-week-end-pourquoi-ny-a-encore-detude-france-246064

[66] Leclerc-Imhoff, F. (2013). Surmortalité à l'hôpital le week-end : pourquoi il n'y a pas (encore) d'étude en France. L'OBS AVEC Rue 89. (see earlier)

[67] Accident and Emergency Medical Care in France. (2012). *French Property . com Website.* Retrieved from http://www.french-property.com/news/french_health/medical_emergency_services/

[68] Bidgood, E., & Clarke, E. (2013b). Healthcare Systems: France (see earlier)

[69] Bidgood, E., & Clarke, E. (2013b). Healthcare Systems: France (see earlier)

[70] Role and Responsibilities. (2015). CNIL (Commission Nationale de l'Information et des Libertés). Retrieved from http://www.cnil.fr/english/the-cnil/role-and-responsabilities/ (23/01/15).