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What's in a number? Communicating risk through real-world examples

George Chapman

Adult Intensive Care Unit, John Radcliffe Hospital, Headley Way, Headington, Oxford, OX3 9DU, UK

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ABSTRACT

"Don't worry, it's more dangerous driving here than having the anaesthetic". This statement may be reassuring, but it isn't true. Despite its falsehood, it is often quoted as it evokes a visceral response that suggests the procedure is low risk.

Communicating risks and probabilities to our patients is an everyday occurrence for clinicians - but are we correctly understood? Are we over-reliant on numerical expressions of risk? Could comparative examples of probabilities aid the understanding of risk?

In this article the communication of numerical probability in healthcare is examined and a table of commonly used probabilities aims to improve understanding by converting numerical expressions into more tangible, real-world, examples.

To allay a patient's fear of awareness it is perhaps reassuring to know that you are more likely to guess my four-digit bank personal identification number first time than experience awareness during a general anaesthetic. Conversely, and providing much less reassurance, taking ten trips into space with NASA is safer, in terms of 30-day mortality, than an emergency laparotomy in the UK.

Clinicians are invited to trial this method for communicating probability, in carefully chosen circumstances, and read the cues and outcomes from the communication that follows.

"Don't worry, it's more dangerous driving here than having the anaesthetic". There it is again, overheard in a busy day surgery unit. I've even said it myself. I thought it was true. But is it? As with all things, it depends. Which car you drive, the distance, your driving skills, the driving conditions, your physical health, the skills of your surgeon/anaesthetist, the procedure itself, whether your anaesthetist had breakfast [1] and the human factors of the team could all influence the risk a patient is exposed to on a given day.

To test this statement, we will first set the parameters. The procedure will be elective day case surgery on a healthy adult free from comorbidity and therefore a model American Society of Anaesthetists (ASA) grade 1 patient [2]. For this patient, is it truly safer on the table than at the wheel of a car driving to the hospital?

The calculated risk of dying whilst driving to the hospital (in the UK):

In 2015, 247,700,000,000 miles were travelled in a motor vehicle in the UK, with 754 fatalities [3]. Therefore, statistically speaking (though this is a very simplified model), every 328,514,589 miles travelled in a car leads to a death, giving a crude per mile probability of 0.000000003. This translates into a 3 in a billion chance of dying if you drive 1 mile. Let's say you drive 10 miles, because you need to pick up your Aunt Mary who's going to drive you home after your operation. 3 in 1 billion becomes 3 in 100 million, or 1 in 33 million.

Maybe Aunt Mary loves motorcycles and insists you collect her by motorcycle. In the UK there have been 365 deaths in 2.8 billion miles travelled by motorcycle [3]. This converts to a 1.3 in 1 million chance of dying on the same journey to hospital.

The reported change of dying from an elective ASA grade 1 general anaesthetic varies between publications. The risk originates predominantly from airway catastrophe and rare adverse drug reactions. It is probably in the region of 1 in 100,000 [4–7]. It turns out that driving a car to the hospital, in terms of the chance of dying, is over 300 times safer than having an elective general anaesthetic.

It should be noted that with emergency surgery comes a significant increase in risk. In truth this is a combination of risks from the anaesthetic, the procedure itself, the presenting pathology and the postoperative risks. Combining all of these gives an average 30-day mortality following an emergency laparotomy in the UK of

E-mail address: george.chapman@doctors.org.uk.

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approximately 15% [8,9]. The probability of mortality for a given procedure, or factoring in a known comorbidity, can be estimated using scoring systems such as the P-POSSUM [10]. Though application to individual cases was certainly not their intended use, and use in this manner has its shortcomings, it is nonetheless commonplace in clinical practice.

We often express numbers and probabilities, sometimes platitudes, to patients. But how successful is this? Are we often misunderstood? After all, 50% of patients (and physicians) understand numbers less well than average. For further proof of the poor understanding of probability amongst humans the Monty Hall problem [11] is a greatly exasperating example that will leave you wondering how on earth it works: if a TV show host gives you three closed doors and a prize behind only one door, you choose a door then the host opens another door to reveal no prize, and asks you if you want to stick to your choice or twist – what do you say? [spoiler alert: you should twist]. If that hasn't cooked your noodle then try the conjunction fallacy [12]: you notice a foundation year 2 doctor, who you know loves animals, has started cycling to work in ethically-sourced clothing and is losing weight - which is more probable: that they have taken up distance running or taken up distance running and become a vegan? [It's the former, as the probability of two events occurring in "conjunction", i.e. their probabilities multiplied, is always less than the probability of either one occurring alone]. Both of these examples provide frustrating food for thought on the unnatural nature of probability and how we can all be hoodwinked.

In light of this, what is the best method for expressing

Table 1
Probabilities, medical risks and equally probable real-world comparators.

Probability	Medical example	Real-world equivalent
75%	Chance of dying if, during a stay in ITU, you suffer >3 organ failure at any point [20].	After the iceberg collision, the chance of dying during the sinking of the Titanic (68%) [21].
50%	Historical chance of dying if your abdominal aortic aneurysm ruptures [22], modern figures have improved to 27–35% 30-day mortality [8,23]. Chance of having schizophrenia if your identical twin does (48%) [24].	As likely as not. A coin toss.
25%	Chance of headache after lumbar puncture (varies with patient group, technique and needle size, but approximates to 20–25%) [25]. In-hospital mortality if in acute kidney injury (AKI) stage 2 (creatinine 2-3x greater than baseline) (25.6%). In AKI stage 3 the figure is 33% [26,27].	Chance of guessing a coin toss correctly twice in a row.
15%	Chance that a 60 year old male who smokes 15 cigarettes per day will have a myocardial infarction or stroke in the next 10 years [28].	On the standard dice layout, the chance of rolling a six is 16.67%.
10%	Chance of dying if you were admitted to HDU/ITU with influenza during winter 2016-17 [29]. 30-day mortality from ST-elevation myocardial infarction in the UK is approximately 8% [30].	Probability of matching two numbers on the UK lottery (9.7%) [31].
5%	Chance of dying in 30 days if a saddle pulmonary embolus (PE) is found on CT pulmonary angiography [32,33] (crucially this excludes a significant group with fatal pulmonary emboli presenting as sudden death in the community and those too unstable for CTPA) [33,34]. Chance of arterial puncture in central line placement [35].	If you bet on two numbers on a European roulette wheel, the chance you will win is 5.4% (each number has a 1/37 or 2.7% chance of the ball landing on it).
2.5%	30-day mortality following non-ST elevation MI. Datasets quite variable depending upon source: 2.5–3% appears to be a fair approximation [36–38].	Chance of randomly guessing the winner of the Grand National (40 runners). Chance of winning £25 by matching three numbers on the lottery (slightly under 2%). Chance of rolling two sixes with two dice (2.8%).
1.5%	Chance of having a child with trisomy 21 as a 41 year old mother [39,40]. Chance of pneumothorax from permanent pacemaker insertion (variable between centres at 0.5% - 5%, with a mean of approx. 1.5%) [41].	Chance of having twins (either monozygotic or dizygotic) [42]. Chance of dying per journey into space with NASA (14 deaths from 848 person-flights) [43].
1%	Chance of cardiac perforation from atrial fibrillation ablation [44].	Chance of dying if trying to summit Mt. Everest [45].
0.5% 1 in 200	Risk of agranulocytosis with carbimazole [46].	Chance of rolling three dice and getting three sixes first time (1 in 216).
1 in 300	Chance of becoming HIV positive after a needlestick injury from an HIV positive patient [47].	1 in 336: the chance of randomly guessing correctly the top three finishers, in the correct order, in an 8-horse race.
1 in 1000	Bowel perforation from colonoscopy [48]. Cardiac tamponade after percutaneous coronary intervention [49]. Endophthalmitis after cataracts surgery [50,51].	Randomly guessing the combination to a three bezel padlock correctly on the first attempt (if each bezel contains nought to nine inclusive).
1 in 2500	Approximate chance, per year, of having a deep vein thrombosis or PE as a 25–35 year old woman (without the oral contraceptive pill, with the OCP it is three times higher) [52–54].	Chance of guessing someone's bank PIN (personal identification number) if you have four random attempts. Chance of matching four numbers in the UK lottery is approx. 1 in 2000
1 in 5000	If a young adult catches chickenpox, this is the chance of dying from the infection [55]. Chance of can't intubate, can't ventilate scenario during general anaesthesia induction [56,57].	Lifetime risk of dying in a plane crash if you fly twice a week for 4 decades [58] (for airlines based in the EU). [Risk of death per flight is 1 in 17 million].
1 in 10,000	Chance of dying from a flexible bronchoscopy [59,60]. Approximate chance of anaphylaxis during anaesthesia [61,62].	Randomly guessing someone's bank PIN first time.
1 in 20,000	Risk of accidental awareness during a general anaesthetic [63].	Lifetime risk of death or serious injury from a shark attack if you live in Australia [64].
1 in 100,000	Approximate risk of malignant hyperthermia during a general anaesthetic [65].	Chance of dying in a first parachute jump [66]. Risk of sudden death during a marathon [67–69].
1 in a million	Probability of anaphylaxis following vaccination [70].	Correctly guessing the six digits of someone's home phone number. Chance of dying from one day of skiing/snowboarding [71].
1 in 20 million	Chance of disseminated encephalomyelitis after flu vaccination [72].	Chance of being killed by lightning this year [73].
1 in 50 million	Chance of contracting "airport malaria" (from a stowaway mosquito; 14 UK cases in 30 years) during a delayed transit through London Heathrow Airport (grossly approximated) [74,75].	Full jackpot win on the lottery (numbers selected from 1 to 59 since 2015).

probabilities or risks to patients [13]? For some patients numerical probability can be safely used, but for others different formats (or a combination of formats) may well improve understanding [14,15]. Could medical communication and understanding of risk be improved by relative arguments [16]? For example the oft-quoted (though largely unverified) "you are more likely to be killed by a falling coconut than by a shark" – induces a more visceral feeling that shark attacks are vanishingly rare when compared with the (actually true in terms of global averages) statement that you have a 1/4,000,000 lifetime probability of being killed by a shark [17]. This is perhaps an opportune time to state that, if you live in Oxfordshire - a landlocked county in the United Kingdom - and have never crossed the hallowed county border, your probability of being killed by a live shark is zero. If you're a Californian surfing instructor your risk is significantly higher. All of the figures in this article are generated from simplified models or averages based upon certain populations. Individualisation of risk estimates would be the ideal – a combination of the patient's comorbidities, ASA grade, age, procedure, seniority of operator or whether the procedure is undertaken out of hours could all potentially factor into a more accurate estimate. In addition, if local data is available for the centre in question or the operating surgeon regarding risks/complications/outcomes following a given procedure then these local estimates are more likely to be a fair representation of the risk that particular patient is going to encounter. Despite the many factors that can influence risk, more often than not the best available data is a published average, often from a subpopulation with limited comparability to the patient in question. The simplification of all these elements into population averages does compromise accuracy. As the eminent statistician George Box rightly said "all models are wrong, but some are useful".

Numerical probabilities are often stated in medical literature or quoted to patients. Can these probabilities be converted to a more tangible format to aid communication with patients and facilitate a greater understanding?

Table 1 provides a grounding in reality for commonly used probabilities. I hope that it will, in the right circumstances, provide a more real-life understanding to patients when a given risk or probability is to be communicated. These examples could also facilitate a more rounded understanding of risk for clinicians in training.

Many of the real-world equivalent risks described are based in gaming or betting or refer to events that are within the public consciousness. 70% of the UK population play the lottery regularly [18], 20% place a bet on the grand national horse race each year and over a billion people worldwide have played the boardgame Monopoly® [19] and therefore have a feeling for the outcome of two dice when rolled. By drawing on pre-existing experience of outcomes we can replace numerical probabilities with a more innate comprehension of the possibilities that may occur.

Some of the real-world equivalent descriptions are highly emotive, and that is part of the power in their usage. The mere mention of the Titanic must be handled sensitively and should be deployed only in very carefully chosen circumstances. It does, however, successfully represent the idea of grave danger and a very likely negative outcome, but also one where there were some survivors. Conversely, mentioning a roulette wheel or a horse race could be deemed flippant when faced with a very unwell patient. Other patients, for a variety of reasons, may abhor gambling or games of chance. To succeed, communication must always be placed within its cultural context and tailored to the individual. The examples chosen from the table are no exception. To facilitate this the table is not necessarily to be read with each row in isolation. Making relative statements such as x is more/less likely than y allows more appropriate comparators to be utilised from other rows.

I discussed this topic in a seminar recently - at the end, between two slumbering colleagues, someone's hand lingered gingerly in the air at the back of the room: "a probability is grand, but what you do with that number will ultimately be emotional rather than mathematical". They were, and still are, absolutely right. Humans are emotional creatures. To some a 1% chance of pulmonary embolism is reassurance to head out on their holidays and never think about it again. To others 1% is staggeringly high, they update their will and begin reflecting on which song to play as the procession exits their funeral. Managing these emotions is a complex business, and I do not profess to be an expert. I once tried to tackle a patient's excessive flippancy towards his emergency operation by telling him that his operation was more dangerous than 15 trips up Everest. It is fair to say this method can be too successful.

This article provides an approach to risk communication. Effective communication is not a single method or a protocol, it is knowing your patient, reading their responses and other cues and adapting to optimise the flow of information, and emotion, in both directions. I invite clinicians to try this approach, try expressing the risk of awareness in a general anaesthetic not as 1 in 20,000 but as, "you are more likely to guess my bank PIN than experience awareness during a general anaesthetic". Read the cues in your patient following this, the relaxation in their muscles and the hint of a smile. This method chooses to move towards examples that many in the UK have experience of and away from purely numerical communication. The comparator of a bank PIN also associates with security and safety as well as informing the patient, in a more tangible way, that the risk is very low indeed.

What's in a number? Quite a lot it turns out. True communication is the message received rather than the message transmitted. Expressing probability using real-world equivalents could help us all to communicate more effectively.

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References

[1] M. Tanaka, K. Mizuno, S. Fukuda, Y. Shigihara, Y. Watanabe, Relationships between dietary habits and the prevalence of fatigue in medical students, Nutrition 24 (10) (2008) 985–989.
[2] R. Dripps, New Classification of Physical Status, vol. 24, 1963, p. 111. Anesthesiology.; 1963.
[3] Reported Road Casualties in Great Britain: Main Results, 2015. Office National Statistics; 2015, www.gov.uk/government/collections/road-accidents-and-safetystatistics.
[4] N. Buck, The report of a confidential enquiry into peri-operative deaths, in: H. Devlin (Ed.), Nuffield Provincial Hospitals Trust and the King's Fund, 1987.
[5] T. Pederson, Serious morbidity attributable toanaesthesia. Considerations for prevention, in: S. Johansen (Ed.), 44: 504–8. Anaesthesia, 1989.
[6] T.J. Hopkins, K. Raghunathan, A. Barbeito, M. Cooter, M. Stafford-Smith, R. Schroeder, et al., Associations between ASA Physical Status and post-operative mortality at 48 h: a contemporary dataset analysis compared to a historical cohort, Perioper. Med. 5 (2016) 29.
[7] M.R. Sury, J.H. Palmer, T.M. Cook, J.J. Pandit, The state of UK anaesthesia: a survey of National Health Service activity in 2013, Br. J. Anaesth. 113 (4) (2014) 575–584.
[8] T.E.F. Abbott, A.J. Fowler, T.D. Dobbs, E.M. Harrison, M.A. Gillies, R.M. Pearse, Frequency of surgical treatment and related hospital procedures in the UK: a national ecological study using hospital episode statistics, Br. J. Anaesth. 119 (2) (2017) 249–257.
[9] D.I. Saunders, D. Murray, A.C. Pichel, S. Varley, C.J. Peden, U.E.L. Network, Variations in mortality after emergency laparotomy: the first report of the UK Emergency Laparotomy Network, Br. J. Anaesth. 109 (3) (2012) 368–375.
[10] D.R. Prytherch, M.S. Whiteley, B. Higgins, P.C. Weaver, W.G. Prout, S.J. Powell, POSSUM and portsmouth POSSUM for predicting mortality. Physiological and

operative severity score for the enUmeration of mortality and morbidity, Br. J. Surg. 85 (9) (1998) 1217–1220.
[11] J. Baratgin, Rationality, the bayesian standpoint, and the monty-Hall problem, Front. Psychol. 6 (2015) 1168.
[12] G. Rao, Probability error in diagnosis: the conjunction fallacy among beginning medical students, Fam. Med. 41 (4) (2009) 262–265.
[13] A. Fagerlin, B.J. Zikmund-Fisher, P.A. Ubel, Helping patients decide: ten steps to better risk communication, J. Natl. Cancer Inst. 103 (19) (2011) 1436–1443.
[14] V.F. Reyna, W.L. Nelson, P.K. Han, N.F. Dieckmann, How numeracy influences risk comprehension and medical decision making, Psychol. Bull. 135 (6) (2009) 943–973.
[15] A. Fagerlin, P.A. Ubel, D.M. Smith, B.J. Zikmund-Fisher, Making numbers matter: present and future research in risk communication, Am. J. Health Behav. 31 (Suppl 1) (2007) S47–S56.
[16] S. Thorne, T.G. Hislop, M. Kuo, E.A. Armstrong, Hope and probability: patient perspectives of the meaning of numerical information in cancer communication, Qual. Health Res. 16 (3) (2006) 318–336.
[17] International shark attack file, 2018. www.floridamuseum.ufl.edu.
[18] Accessed, www.lottoland.co.uk/magazine/lottery-demographics.html. (Accessed 20 September 2019).
[19] Accessed, www.oxfordgames.co.uk/do-not-pass-go-the-secret-history-of-monopoly/. (Accessed 20 September 2019).
[20] Y. Sakr, S.M. Lobo, R.P. Moreno, H. Gerlach, V.M. Ranieri, A. Michalopoulos, et al., Patterns and early evolution of organ failure in the intensive care unit and their relation to outcome, Crit. Care 16 (6) (2012) R222.
[21] Accessed, http://blog.minitab.com/blog/real-world-quality-improvement/analyzing-titanic-survival-rates. (Accessed 18 February 2019).
[22] M.J. Bown, N.J. Cooper, A.J. Sutton, D. Prytherch, M.L. Nicholson, P.R. Bell, et al., The post-operative mortality of ruptured abdominal aortic aneurysm repair, Eur. J. Vasc. Endovasc. Surg. 27 (1) (2004) 65–74.
[23] S. Badger, R. Forster, P.H. Blair, P. Ellis, F. Kee, D.W. Harkin, Endovascular treatment for ruptured abdominal aortic aneurysm, Cochrane Database Syst. Rev. 5 (2017) CD005261.
[24] F. Mattejat, H. Remschmidt, The children of mentally ill parents, Dtsch Arztebl Int 105 (23) (2008) 413–418.
[25] A.E. Monserrate, D.C. Ryman, S. Ma, C. Xiong, J.M. Noble, J.M. Ringman, et al., Factors associated with the onset and persistence of post-lumbar puncture headache, JAMA Neurol 72 (3) (2015) 325–332.
[26] M. Bedford, P.E. Stevens, T.W. Wheeler, C.K. Farmer, What is the real impact of acute kidney injury? BMC Nephrol. 15 (2014) 95.
[27] N.M. Selby, N.V. Kolhe, C.W. McIntyre, J. Monaghan, N. Lawson, D. Elliott, et al., Defining the cause of death in hospitalised patients with acute kidney injury, PLoS One 7 (11) (2012), e48580.
[28] https://qrisk.org/2017/index.php.
[29] England PH. Surveillance of Influenza and Other Respiratory Viruses in the UK: Winter 2016 to 2017.
[30] NICOR, Myocardial Ischaemia National Audit Project (MINAP) Report, 2014. www.nicor.org.uk/wp-content/uploads/2019/02/minap-public-report-2014.pdf.
[31] https://www.statslife.org.uk.
[32] A. Sardi, J. Gluskin, A. Guttentag, M.N. Kotler, L.E. Braitman, M. Lippmann, Saddle pulmonary embolism: is it as bad as it looks? A community hospital experience, Crit. Care Med. 39 (11) (2011) 2413–2418.
[33] E. Gandara, G. Bose, P. Erkens, M. Rodgers, M. Carrier, P. Wells, Outcomes of saddle pulmonary embolism: a nested case-control study, J. Thromb. Haemost. 9 (4) (2011) 867–869.
[34] K. Janata, M. Holzer, H. Domanovits, M. Müllner, A. Bankier, A. Kurtaran, et al., Mortality of patients with pulmonary embolism, Wien. Klin. Wochenschr. 114 (17–18) (2002) 766–772.
[35] C. Kornbau, K.C. Lee, G.D. Hughes, M.S. Firstenberg, Central line complications, Int J Crit Illn Inj Sci 5 (3) (2015) 170–178.
[36] 30-day mortality after AMI drops with improved treatment, European Society of Cardiology, www.escardio.org/The-ESC/Press-Office/Press-releases/30-day-mortality-after-AMI-drops-with-improved-treatment, 2012.
[37] D. Brieger, K.A. Fox, G. Fitzgerald, K.A. Eagle, A. Budaj, A. Avezum, et al., Predicting freedom from clinical events in non-ST-elevation acute coronary syndromes: the Global Registry of Acute Coronary Events, Heart 95 (11) (2009) 888–894.
[38] Invasive compared with non-invasive treatment in unstable coronary-artery disease: FRISC II prospective randomised multicentre study. FRagmin and Fast Revascularisation during InStability in Coronary artery disease Investigators, Lancet 354 (9180) (1999) 708–715.
[39] R.J. Snijders, K. Sundberg, W. Holzgreve, G. Henry, K.H. Nicolaides, Maternal age- and gestation-specific risk for trisomy 21, Ultrasound Obstet. Gynecol. 13 (3) (1999) 167–170.
[40] E.G. Allen, S.B. Freeman, C. Druschel, C.A. Hobbs, L.A. O'Leary, P.A. Romitti, et al., Maternal age and risk for trisomy 21 assessed by the origin of chromosome nondisjunction: a report from the Atlanta and National Down Syndrome Projects, Hum. Genet. 125 (1) (2009) 41–52.
[41] M. Kotsakou, I. Kioumis, G. Lazaridis, G. Pitsiou, S. Lampaki, A. Papaiwannou, et al., Pacemaker insertion, Ann. Transl. Med. 3 (3) (2015) 42.
[42] ONS, Birth Characteristics in England and Wales: Statistical Bulletin, 2016.
[43] www.nasa.gov.
[44] E. Arbelo, J. Brugada, G. Hindricks, A. Maggioni, L. Tavazzi, P. Vardas, et al., ESC-EURObservational research programme: the atrial fibrillation ablation pilot study, conducted by the european heart rhythm association, Europace 14 (8) (2012) 1094–1103.
[45] P.G. Firth, H. Zheng, J.S. Windsor, A.I. Sutherland, C.H. Imray, G.W. Moore, et al., Mortality on mount everest, 1921-2006: descriptive study, BMJ 337 (2008) a2654.
[46] J. Cepková, F. Gabalec, I. Svilias, J. Horáček, [The occurrence of agranulocytosis due to antithyroid drugs in a cohort of patients with Graves disease treated with radioactive iodine 131I during 14 years], Vnitr. Lek. 60 (10) (2014) 832–836.
[47] C.E. Becker, J.E. Cone, J. Gerberding, Occupational infection with human immunodeficiency virus (HIV). Risks and risk reduction, Ann. Intern. Med. 110 (8) (1989) 653–656.
[48] T.H. Lüning, M.E. Keemers-Gels, W.B. Barendregt, A.C. Tan, C. Rosman, Colonoscopic perforations: a review of 30,366 patients, Surg. Endosc. 21 (6) (2007) 994–997.
[49] M. Fejka, S.R. Dixon, R.D. Safian, W.W. O'Neill, C.L. Grines, B. Finta, et al., Diagnosis, management, and clinical outcome of cardiac tamponade complicating percutaneous coronary intervention, Am. J. Cardiol. 90 (11) (2002) 1183–1186.
[50] H. Cao, L. Zhang, L. Li, S. Lo, Risk factors for acute endophthalmitis following cataract surgery: a systematic review and meta-analysis, PLoS One 8 (8) (2013), e71731.
[51] M. Lundström, E. Friling, P. Montan, Risk factors for endophthalmitis after cataract surgery: predictors for causative organisms and visual outcomes, J. Cataract Refract. Surg. 41 (11) (2015) 2410–2416.
[52] Y. Vinogradova, C. Coupland, J. Hippisley-Cox, Use of combined oral contraceptives and risk of venous thromboembolism: nested case-control studies using the QResearch and CPRD databases, BMJ 350 (2015) h2135.
[53] M.D. Silverstein, J.A. Heit, D.N. Mohr, T.M. Petterson, W.M. O'Fallon, L.J. Melton, Trends in the incidence of deep vein thrombosis and pulmonary embolism: a 25-year population-based study, Arch. Intern. Med. 158 (6) (1998) 585–593.
[54] M. de Bastos, B.H. Stegeman, F.R. Rosendaal, A. Van Hylckama Vlieg, F.M. Helmerhorst, T. Stijnen, et al., Combined oral contraceptives: venous thrombosis, Cochrane Database Syst. Rev. 3 (2014) CD010813.
[55] H. Rawson, A. Crampin, N. Noah, Deaths from chickenpox in England and Wales 1995-7: analysis of routine mortality data, BMJ 323 (7321) (2001) 1091–1093.
[56] S. Kheterpal, L. Martin, A.M. Shanks, K.K. Tremper, Prediction and outcomes of impossible mask ventilation: a review of 50,000 anesthetics, Anesthesiology 110 (4) (2009) 891–897.
[57] T. Nagaro, T. Yorozuya, M. Sotani, N. Adachi, E. Tabo, T. Arai, et al., Survey of patients whose lungs could not be ventilated and whose trachea could not be intubated in university hospitals in Japan, J. Anesth. 17 (4) (2003) 232–240.
[58] Civil Aviation Authority, Global Fatal Accident Review 2002 to 2011, 2013.
[59] W.F. Credle, J.F. Smiddy, R.C. Elliott, Complications of fiberoptic bronchoscopy, Am. Rev. Respir. Dis. 109 (1) (1974) 67–72.
[60] P.M. Suratt, J.F. Smiddy, B. Gruber, Deaths and complications associated with fiberoptic bronchoscopy, Chest 69 (6) (1976) 747–751.
[61] T. Harboe, A.B. Guttormsen, A. Irgens, T. Dybendal, E. Florvaag, Anaphylaxis during anesthesia in Norway: a 6-year single-center follow-up study, Anesthesiology 102 (5) (2005) 897–903.
[62] M.M. Fisher, B.A. Baldo, The incidence and clinical features of anaphylactic reactions during anesthesia in Australia, Ann. Fr. Anesth. Reanim. 12 (2) (1993) 97–104.
[63] J.J. Pandit, J. Andrade, D.G. Bogod, J.M. Hitchman, W.R. Jonker, N. Lucas, et al., 5th National Audit Project (NAP5) on accidental awareness during general anaesthesia: summary of main findings and risk factors, Br. J. Anaesth. 113 (4) (2014) 549–559.
[64] Australian Shark Attack File, 2016.
[65] J.E. Brady, L.S. Sun, H. Rosenberg, G. Li, Prevalence of malignant hyperthermia due to anesthesia in New York State, 2001-2005, Anesth. Analg. 109 (4) (2009) 1162–1166.
[66] https://www.bpa.org.uk/staysafe/how-safe/. British Parachute Association.
[67] D.S. Tunstall Pedoe, Marathon cardiac deaths : the london experience, Sport. Med. 37 (4–5) (2007) 448–450.
[68] S.C. Mathews, D.L. Narotsky, D.L. Bernholt, M. Vogt, Y.H. Hsieh, P.J. Pronovost, et al., Mortality among marathon runners in the United States, 2000-2009, Am. J. Sports Med. 40 (7) (2012) 1495–1500.
[69] L. Hart, Marathon-related cardiac arrest, Clin. J. Sport Med. 23 (5) (2013) 409–410.
[70] Department of Health Vaccine Safety and the Management of Adverse Events Following Immunisation. I*mmunisation against Infectious Disease* . London: Department of Health, 200653–200664.
[71] (National Ski Areas Association), https://www.nsaa.org/media/68045/NSAA-Facts-About-Skiing-Snowboarding-Safety-10-1-12.pdf.
[72] P. Pellegrino, S. Radice, E. Clementi, Acute disseminated encephalomyelitis following influenza vaccine, Epidemiology 26 (1) (2015) e12–e13.
[73] Accessed, https://www.rospa.com/leisure-safety/advice/lightning/. (Accessed 18 February 2019).
[74] N.G. Gratz, R. Steffen, W. Cocksedge, Why aircraft disinsection? Bull. World Health Organ. 78 (8) (2000) 995–1004.
[75] CAA. https://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Data_and_analysis/Datasets/Passenger_survey/CAA%20Passenger%20survey%20report%201991.pdf, 1991.