RGA | Global Research and Data Analytics

Unnatural Cause of Death Experience

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Executive Summary

The World Health Organization (WHO) Mortality Database is a very valuable tool for comparative analysis across all causes of death for a wide range of countries. We used the WHO Mortality Database to perform a review of unnatural death trends within seven countries that are experiencing notable unnatural death mortality.

We analyzed trends over a period of more than 35 years. The table below summarizes our key findings by cause of unnatural death:

Cause	Finding
Motor Vehicle Accidents	After years of significant improvement in all countries, the last few years show that improvement has leveled off or declined in most countries
Accidental Poisoning (including drug overdoses)	Significant worsening in the United States (U.S.), United Kingdom (U.K.), Canada, and France. France is notable in that older people contributed more to the decline than younger people.
Suicide	Low rates in the U.K. and Italy. Highest in the U.S. and France. Suicide rates have steadily increased in the U.S. for the last 15 years, while steadily decreasing in France over the past 30 years. Canada has also seen rates increase in recent years.
Homicide	Homicide rates are a problem limited mostly to the U.S. After years of general improvement, rates have begun climbing again in the most recent years. The increase in the U.S. between 2013 and 2016 alone would be larger than the total rate for most countries in the most recent year of data.

The 2015 report stated that the U.S. is the only country to see periods of unnatural death mortality deterioration. That is no longer the case. Canada, the U.K., and even Hong Kong SAR have experienced deteriorating unnatural death mortality since 2011.

This report provides a dedicated section on the opioid crisis, which has been widely discussed and researched in recent years, as well as details about other important trends related to unnatural causes of death.

Given the depth, breadth, and quality of the data in the WHO Mortality Database, we believe it will prove useful in many ongoing and future research endeavors. However, the user must be mindful of differences in how cause of death data is recorded among different countries and over time.

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Introduction

The WHO Mortality Database contains a time-series of mortality rates, classified by cause of death, for a large number of countries (World Health Organization, 2019). We used this database to calculate unnatural death rates for select countries with a combination of criteria:

- Populations large enough to provide relatively stable results over time
- Length of time-series available, to enable assessment of trends

We examined seven countries for our detailed report analysis. The table below shows the seven countries selected and our rationale for each. The table is ordered broadly with the countries experiencing the highest unnatural death rates at the top of the table:

Country	Rationale	Other Interesting Features
France	Highest unnatural death rates among large developed countries.	Despite high rates, France has experienced consistent improvement in the last 30 years.
United States	High levels of unnatural death rates were followed by a period of improvement, which has deteriorated over the last 15 years.	Accidental Poisoning rates have deteriorated. Significantly higher level of homicide deaths compared to other countries.
Canada		
Italy	Moderate experience initially, followed by relatively strong improvement.	
Hong Kong SAR	Consistently among the very lowest rates in the past 30 years. Another option here would have been the Netherlands.	
Singapore		After an initial deterioration of rates, Singapore's rates have improved relative to that of Hong Kong SAR and the U.K.
U.K.		

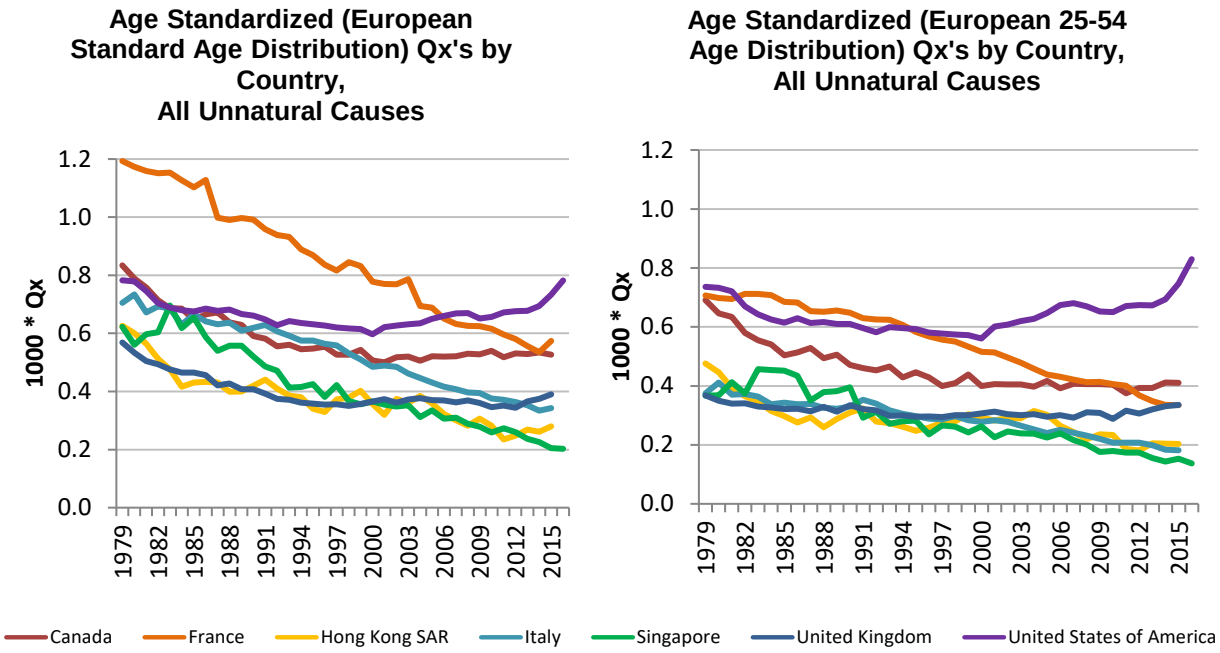
The following report examines all seven countries in more detail. For France, Canada, Italy, the U.K., and the U.S., we have sufficient data to extend this analysis down to an age-banded analysis. All results include both sexes.

This is an update for a 2015 bulletin, a summary version of which can be found here. The countries covered are identical to those examined in 2015.

Categorizations of Unnatural Deaths

Name	Description
Motor Vehicle Traffic Accidents (MVA)	Motor vehicle accident deaths where the accident takes place on a public highway/road only. Other transport-related accidents are included below.
Accidental Poisoning	Predominantly includes drug overdoses, but also includes accidental exposure to other poisonous substances.
Other Accidents	Non-motor vehicle accidents, including most importantly accidental falls which largely drives the experience at the older ages. Excludes the accidental poisoning deaths counted above.
Suicide	
Homicide	
Other Violence	Includes injuries from legal intervention, acts of undetermined intent, and war operations.
Other Unnatural	Transport-related accidents not categorized above, including: • non-motor vehicle accidents on a road (e.g., cyclists, pedestrians) • off-road motor vehicles (e.g., recreational or sporting vehicles) • Railway, water, air, and space accidents • Misadventures to patients during medical care

Overall Population Results by Country



All graphs that do not include age used the European Standard Population to age-standardize either for all ages or for ages 25-54 as designated in the graphs (National Records of Scotland, 2019). The age range 25-54 was chosen as the period during which the most term assurance exposure occurs and unnatural deaths are most significant.

Confidence intervals are not shown on any of the age standardized graphs because they are generally very narrow, do not alter the conclusions, and confuse the graphs.

Although most of these countries' rates of unnatural death improved over the last 35 years, France saw the most dramatic improvement, starting at a level nearly double that of some countries and now with rates similar to Canada. Hong Kong SAR and Singapore have relatively low unnatural death rates, while Italy and the U.K. are mid-pack.

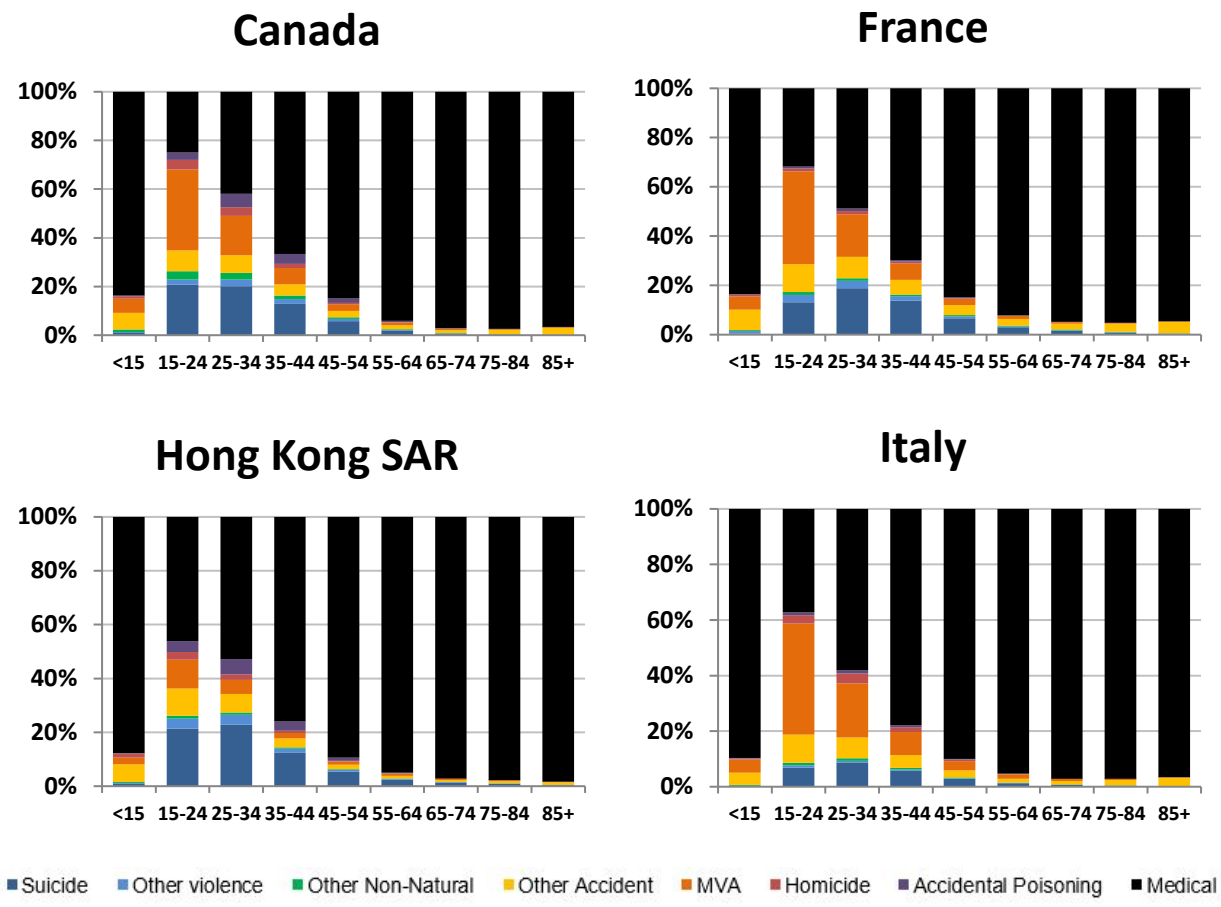
The 2015 report stated that the U.S. is the only country to see periods of mortality deterioration. That is no longer the case. Deterioration has also occurred in Canada, the U.K., and even Hong Kong SAR since 2011.

The improvement in France and deterioration in the U.S. can both be traced to accidental deaths. This update splits accidental deaths between Accidental Poisonings (including drug overdoses) and Other Accidents. The latter category has largely driven improvements in France, whereas the opioid epidemic has deteriorated conditions in the U.S.

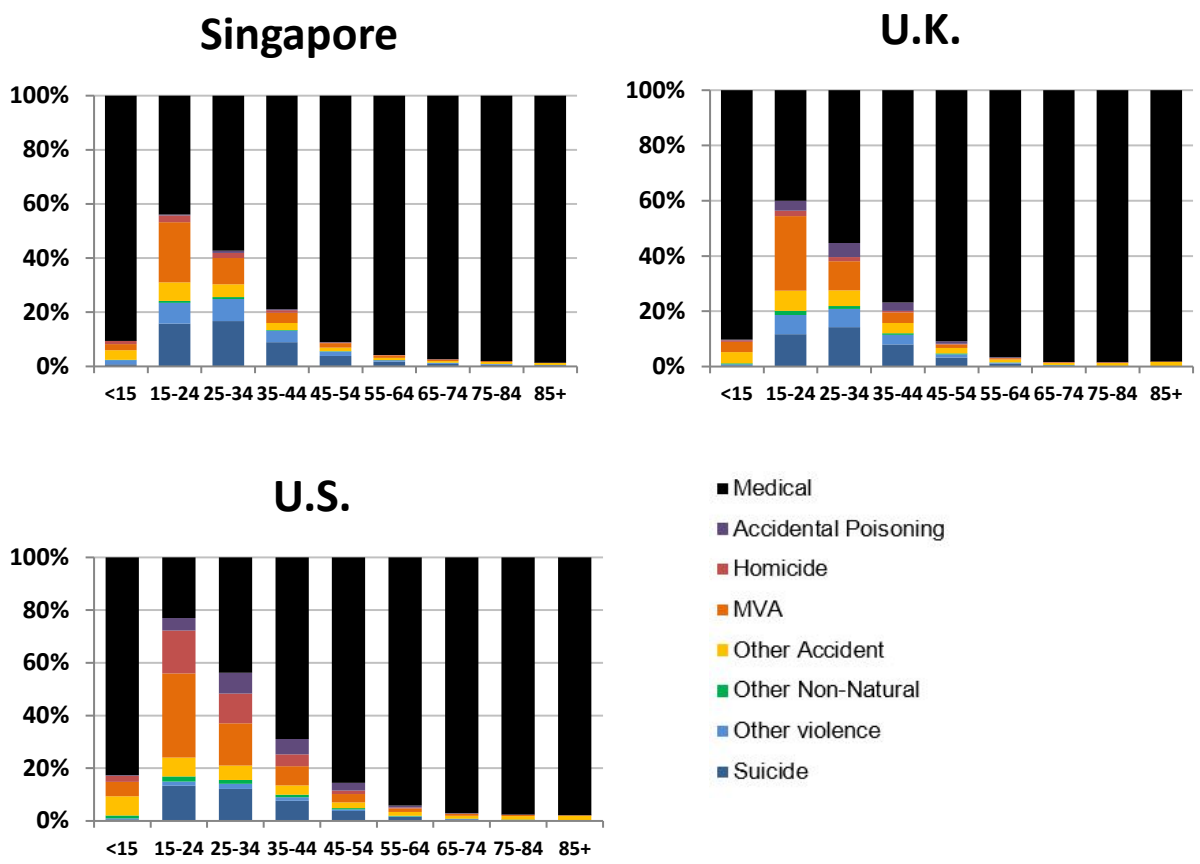
Relative Importance of Unnatural Deaths

The following graphs demonstrate the proportion of unnatural deaths, by sub-cause, within each age band. Aggregated deaths dating back to 1979 are included in these proportions.

Distributions by Cause and Age



GST



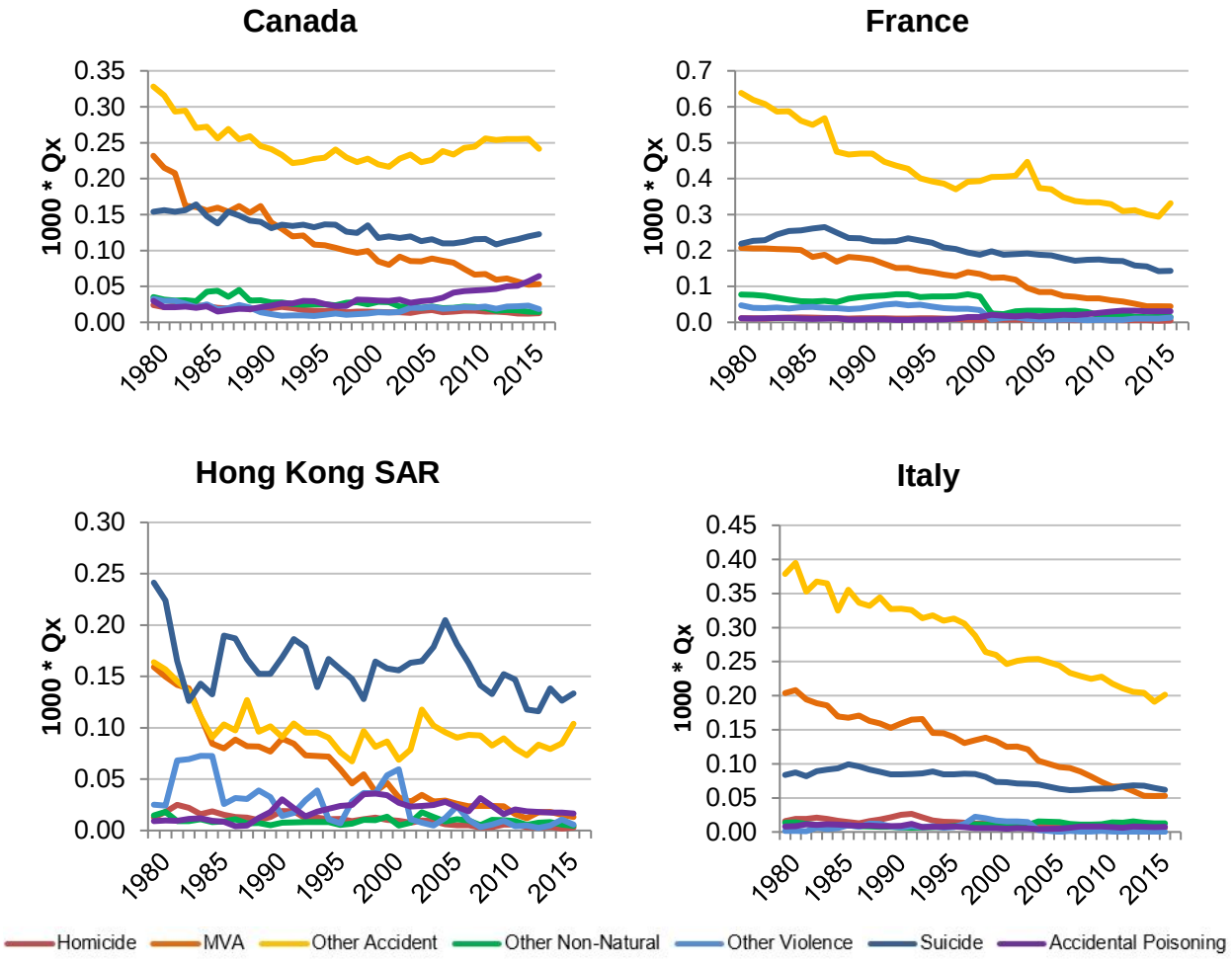
Medical deaths in the charts are displayed in black with the unnatural deaths displayed with bright colors. These charts make it clear that motor vehicle accidents and suicides have been the most prominent. Homicide is only prominent in the U.S. Accidental poisonings have an increased presence in recent years across multiple countries.

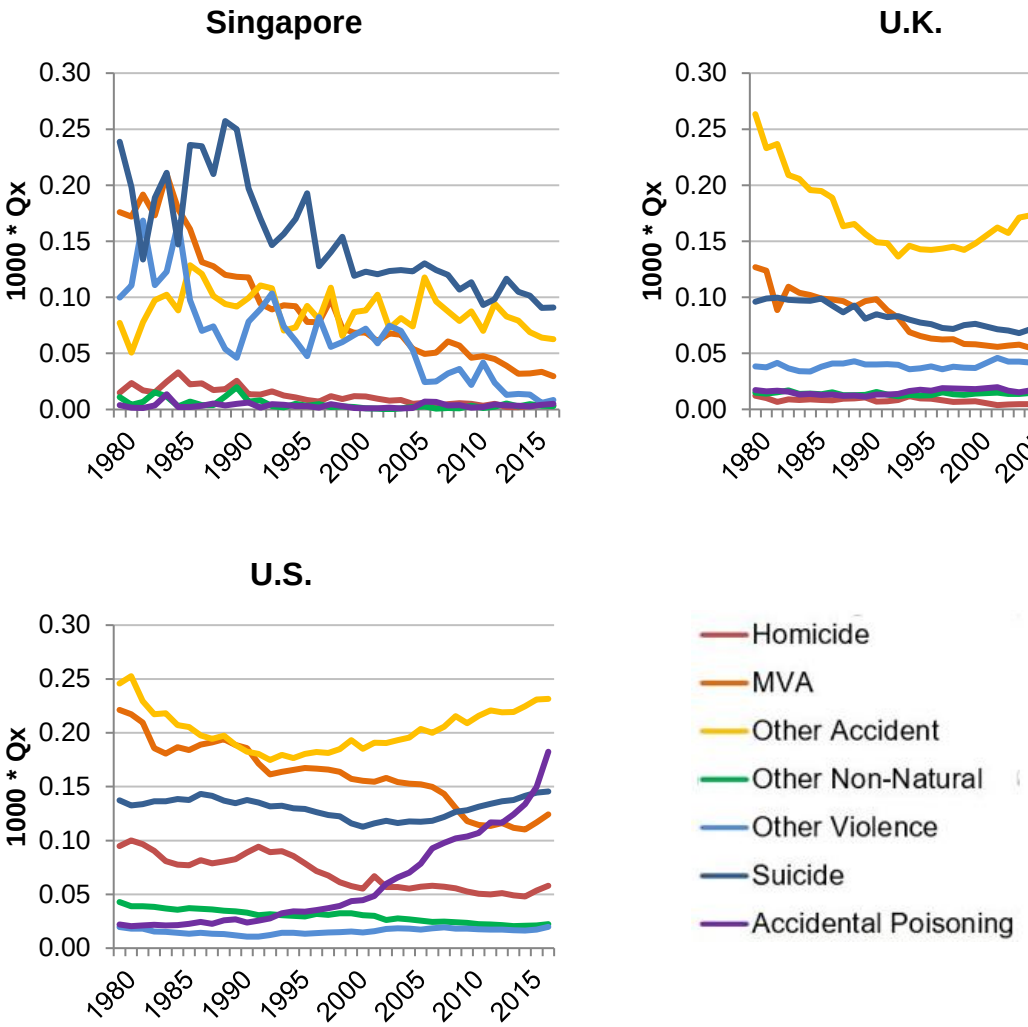
For all countries studied, the proportion of deaths attributable to unnatural causes decreases by age. However, it is interesting to note the difference in the proportion at ages 15-24 by country. In particular, the U.S. and Canada are relatively high at nearly 80% unnatural, while Singapore and Hong Kong SAR are relatively low at about 55%.

Absolute Importance of Unnatural Deaths

The following graphs display the absolute level of age-standardized mortality for each of the unnatural causes of death, by country.

Age-Adjusted (European Standard Distribution) Mortality Rates




Singapore
U.K.
U.S.
1000 * Qx
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1980
1985
1990
1995
2000
2005
2010
2015
Homicide
MVA
Other Accident
Other Non-Natural
Other Violence
Suicide
Accidental Poisoning

Best-in-Class Mortality Adjustments

What if a country could attain the best mortality achieved by their peers for any of the unnatural mortality causes? The next series of tables explore this hypothetical construct, beginning with motor vehicle accidents. For that cause, Hong Kong SAR has the lowest mortality rate across most ages. As shown in the table, if the 15- to 24-year-old group in Italy were to achieve the motor vehicle accident mortality rate of Hong Kong SAR's 15- to 24-year-olds, the all-cause mortality for that age group in Italy would improve by 24.6%

Each table is divided into two parts, and the lower section shows the rate of annual improvement necessary to achieve the stated level over a ten-year period. For example, for Italian 15- to 24-year-olds to attain the corresponding mortality level for those in Hong Kong SAR, their motor vehicle mortality improvement needs to be 20.6% per annum. Cases in which the country with the best mortality rate was 0 would indicate that other countries would need to improve by 100% to achieve that rate. In order to show a more realistic progression, a single death was added to those cohorts.

Motor Vehicle Accidents (MVA) - All Cause Impact of Moving to Best Rate									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	2.0%	15.8%	7.5%	4.9%	1.6%	0.7%	0.3%	0.1%	0.1%
France	2.1%	22.2%	10.0%	4.8%	1.0%	0.2%	0.2%	0.0%	0.0%
Hong Kong SAR	Lowest Overall MVA Mortality								
Italy	1.5%	24.6%	13.6%	7.0%	1.8%	0.7%	0.3%	0.1%	0.0%
Singapore	0.2%	9.2%	5.2%	2.3%	0.8%	0.3%	0.3%	0.1%	0.0%
United Kingdom	0.9%	10.0%	4.0%	1.8%	0.5%	0.0%	0.1%	0.0%	0.0%
United States of America	3.9%	20.8%	11.7%	7.9%	3.0%	1.3%	0.6%	0.3%	0.1%
Motor Vehicle Accidents (MVA) - Cause Specific Annual Improvement Needed to Reach Best Rate within 10 Years									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	18.7%	20.7%	16.8%	16.8%	13.6%	11.1%	11.4%	6.1%	7.1%
France	16.5%	21.0%	17.4%	17.4%	11.6%	6.3%	8.8%	2.3%	4.1%
Hong Kong SAR	Lowest Overall MVA Mortality								
Italy	13.5%	20.6%	17.4%	17.4%	13.4%	10.3%	11.7%	6.8%	4.6%
Singapore	3.2%	12.5%	9.5%	9.5%	8.4%	6.5%	11.6%	6.0%	NA
United Kingdom	11.6%	15.1%	11.4%	11.4%	7.4%	1.0%	3.6%	NA	2.6%
United States of America	24.7%	26.5%	24.8%	24.8%	21.6%	18.3%	18.2%	11.4%	11.3%

Suicide - All Cause Impact of Moving to Best Rate									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	1.1%	18.7%	13.6%	8.9%	4.4%	1.5%	0.2%	0.0%	0.0%
France	0.4%	4.5%	8.8%	4.2%	5.0%	1.7%	0.8%	0.4%	0.2%
Hong Kong SAR	1.8%	20.4%	19.5%	8.1%	2.7%	1.8%	1.0%	0.6%	0.2%
Italy	Lowest Overall Suicide Mortality								
Singapore	2.8%	9.4%	6.1%	2.7%	1.0%	0.8%	0.5%	0.1%	0.1%
United Kingdom	-0.2%	8.5%	7.2%	3.3%	1.4%	0.3%	-0.1%	-0.1%	0.0%
United States of America	1.1%	13.3%	9.1%	6.2%	2.8%	1.2%	0.4%	0.1%	0.0%
Suicide - Cause Specific Annual Improvement Needed to Reach Best Rate within 10 Years									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	12.8%	11.6%	9.8%	9.8%	7.6%	6.8%	2.9%	0.8%	NA
France	5.1%	3.5%	6.5%	6.5%	9.4%	7.9%	7.2%	7.5%	9.5%
Hong Kong SAR	10.7%	8.1%	8.3%	8.3%	4.8%	6.4%	7.9%	9.0%	8.3%
Italy	Lowest Overall Suicide Mortality								
Singapore	15.5%	4.8%	3.1%	3.1%	2.0%	3.8%	5.0%	3.0%	7.3%
United Kingdom	NA	5.7%	5.7%	5.7%	3.6%	1.9%	NA	NA	NA
United States of America	14.3%	12.9%	11.5%	11.5%	8.0%	7.5%	5.6%	4.2%	4.0%

Other Accidents - All Cause Impact of Moving to Best Rate									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	2.8%	3.6%	3.6%	2.3%	2.0%	1.0%	0.9%	1.5%	3.3%
France	2.6%	8.7%	7.9%	3.8%	3.5%	2.3%	2.0%	2.5%	4.3%
Hong Kong SAR	-1.3%	2.0%	4.8%	2.0%	0.5%	0.5%	0.5%	0.3%	0.8%
Italy	-1.1%	4.2%	7.4%	3.8%	1.5%	0.7%	0.5%	1.0%	2.5%
Singapore	Lowest Overall Other Accidents Mortality								
United Kingdom	1.3%	8.6%	6.0%	2.8%	1.8%	0.9%	0.4%	0.8%	1.8%
United States of America	6.6%	3.4%	3.3%	2.2%	1.9%	1.3%	1.0%	1.2%	2.2%
Other Accidents - Cause Specific Annual Improvement Needed to Reach Best Rate within 10 Years									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	8.2%	10.2%	23.2%	14.9%	12.2%	8.2%	7.3%	8.6%	19.1%
France	6.3%	13.8%	27.4%	20.0%	17.2%	13.9%	11.0%	10.8%	21.1%
Hong Kong SAR	NA	4.2%	20.8%	9.9%	4.3%	4.0%	4.0%	1.9%	8.8%
Italy	NA	8.6%	24.8%	15.2%	9.5%	6.0%	4.2%	6.5%	18.1%
Singapore	Lowest Overall Other Accidents Mortality								
United Kingdom	4.2%	13.5%	25.7%	18.3%	11.9%	7.7%	4.3%	6.1%	16.0%
United States of America	14.7%	13.3%	27.4%	19.3%	15.1%	12.1%	9.1%	7.9%	16.5%

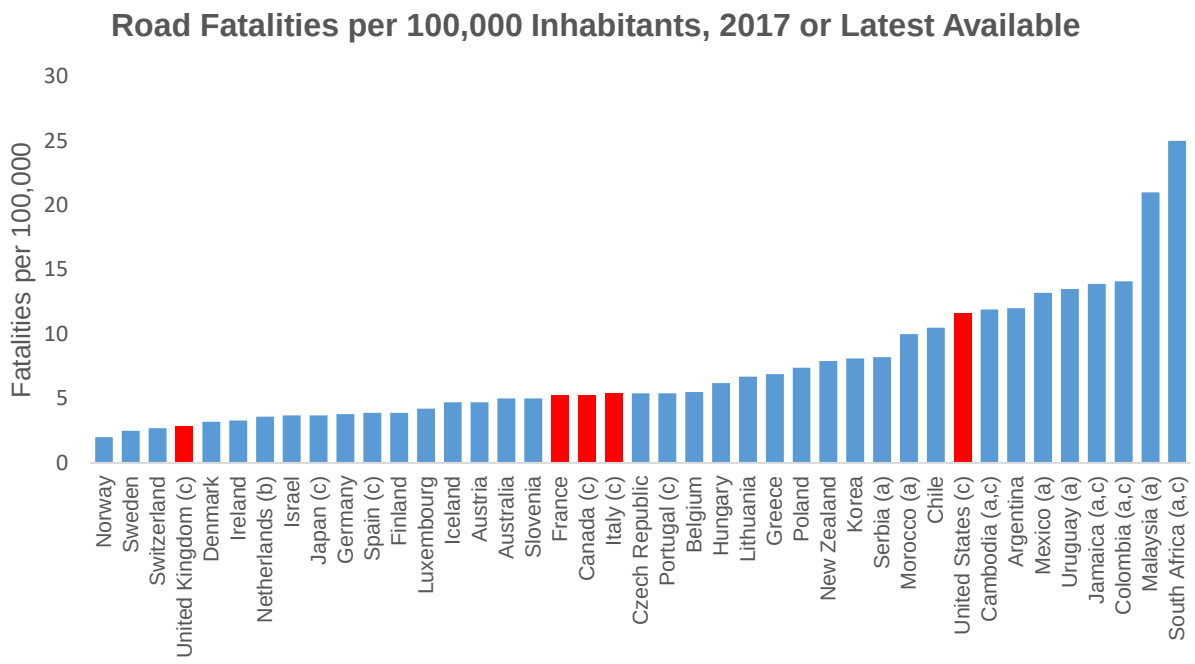
Accidental Poisoning - All Cause Impact of Moving to Best Rate									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	0.3%	9.7%	13.6%	9.6%	4.4%	1.3%	0.2%	0.0%	0.0%
France	0.0%	0.4%	1.1%	1.1%	0.6%	0.4%	0.2%	0.2%	0.2%
Hong Kong SAR	0.5%	-1.2%	2.0%	2.5%	0.9%	0.7%	0.1%	0.0%	0.0%
Italy	Lowest Overall Accidental Poisoning Mortality								
Singapore	0.6%	-0.8%	0.9%	0.7%	-0.4%	-0.1%	0.0%	0.0%	0.0%
United Kingdom	0.0%	7.6%	14.0%	11.8%	3.6%	0.8%	0.1%	0.0%	0.0%
United States of America	0.2%	15.0%	25.0%	16.9%	7.7%	2.6%	0.4%	0.0%	0.0%
Accidental Poisoning - Cause Specific Annual Improvement Needed to Reach Best Rate within 10 Years									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	16.2%	22.2%	20.6%	21.0%	21.1%	24.9%	18.1%	3.6%	NA
France	0.6%	3.0%	4.5%	7.7%	9.4%	16.9%	17.8%	15.5%	18.0%
Hong Kong SAR	14.9%	NA	5.2%	10.7%	9.6%	18.2%	8.5%	NA	NA
Italy	Lowest Overall Accidental Poisoning Mortality								
Singapore	17.7%	NA	2.5%	3.8%	NA	NA	NA	NA	0.8%
United Kingdom	3.6%	18.0%	19.6%	23.7%	20.3%	21.8%	14.3%	1.5%	NA
United States of America	16.0%	29.0%	29.8%	29.5%	28.7%	32.1%	24.1%	4.0%	NA

Homicide - All Cause Impact of Moving to Best Rate									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	0.5%	3.5%	2.9%	1.9%	0.5%	0.2%	0.0%	0.0%	0.0%
France	0.4%	0.8%	0.9%	0.4%	0.1%	0.0%	0.0%	0.0%	0.0%
Hong Kong SAR	0.6%	0.2%	-0.3%	-0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Italy	-0.3%	1.6%	1.8%	0.9%	0.3%	0.1%	0.0%	0.0%	0.0%
Singapore	0.1%	0.0%	0.5%	0.2%	0.2%	0.1%	0.0%	0.0%	0.0%
United Kingdom	Lowest Overall Homicide Mortality								
United States of America	2.7%	15.7%	9.3%	6.3%	1.2%	0.4%	0.1%	0.0%	0.0%
Homicide - Cause Specific Annual Improvement Needed to Reach Best Rate within 10 Years									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	8.4%	19.0%	20.6%	20.6%	19.4%	20.6%	15.6%	22.6%	11.6%
France	6.2%	7.9%	11.6%	11.6%	10.9%	9.0%	9.7%	18.8%	10.9%
Hong Kong SAR	5.4%	1.6%	NA	NA	0.0%	4.1%	13.2%	22.8%	10.8%
Italy	NA	10.6%	13.7%	13.7%	15.1%	13.8%	14.6%	18.6%	12.1%
Singapore	1.9%	NA	5.4%	5.4%	10.4%	16.4%	9.2%	19.6%	21.7%
United Kingdom	Lowest Overall Homicide Mortality								
United States of America	21.1%	33.2%	33.5%	33.5%	29.0%	28.4%	24.4%	27.4%	20.4%

Other Violence - All Cause Impact of Moving to Best Rate									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	0.4%	3.5%	5.1%	3.3%	1.2%	0.3%	0.1%	0.0%	0.0%
France	0.3%	2.4%	2.0%	1.0%	0.6%	0.2%	0.1%	0.1%	0.0%
Hong Kong SAR	0.6%	3.4%	3.9%	1.6%	0.3%	0.0%	0.0%	0.0%	0.0%
Italy	Lowest Overall Other Violence Mortality								
Singapore	2.0%	1.7%	1.7%	0.8%	0.3%	0.2%	0.1%	0.1%	0.0%
United Kingdom	0.3%	6.1%	5.1%	2.3%	1.1%	0.4%	0.1%	0.0%	0.0%
United States of America	0.8%	1.8%	2.3%	1.6%	0.8%	0.3%	0.1%	0.0%	0.0%
Other Violence - Cause Specific Annual Improvement Needed to Reach Best Rate within 10 Years									
Country	<15	15-24	25-34	35-44	45-54	55-64	65-74	75-84	85+
Canada	24.2%	36.2%	41.9%	41.9%	43.1%	39.5%	33.2%	30.1%	28.0%
France	19.9%	31.7%	35.1%	35.1%	39.7%	38.4%	37.7%	38.1%	34.6%
Hong Kong SAR	20.6%	31.5%	36.5%	36.5%	33.0%	23.3%	29.7%	30.6%	22.1%
Italy	Lowest Overall Other Violence Mortality								
Singapore	31.2%	27.1%	30.2%	30.2%	31.9%	34.6%	37.4%	38.8%	31.6%
United Kingdom	19.4%	37.5%	40.8%	40.8%	43.1%	40.7%	37.1%	34.5%	32.2%
United States of America	29.6%	35.4%	41.2%	41.2%	43.5%	41.1%	35.6%	31.8%	28.6%

Motor Vehicle Accidents

The International Transport Forum presents an annual road safety report by the International Traffic Safety Data and Analysis Group (IRTAD, 2018). The document provides country-specific analysis and commentary for 41 countries. The table below is extracted from this report and places five of our seven countries in wider context in terms of road fatality rates per 100,000 of population in 2017. It should be noted that IRTAD uses a slightly different group of ICD codes for their deaths which includes all traffic accidents, whereas we only count *motor vehicle* accidents. Accidents involving an animal-drawn vehicle are a good example of deaths that would be counted under the IRTAD standard but would be grouped with other accidents in our research.



Data for 2017 is provisional.

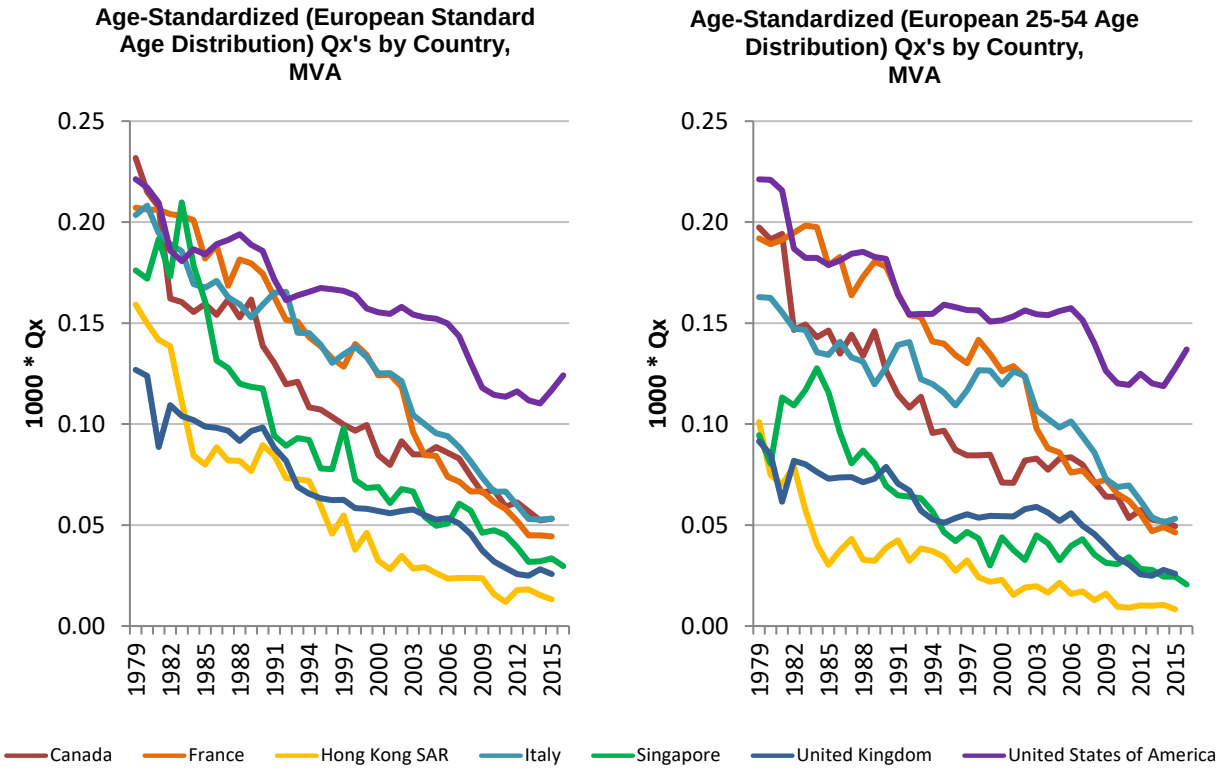
(a) Data as provided by the countries and not validated by IRTAD.

(b) Real data (actual numbers instead of reported numbers by the police).

(c) 2016 data.

By Country

The two graphs below show results extracted from the WHO database using two age standardization mixes; the first covers all ages and the second a younger, 25-54, insured age demographic.

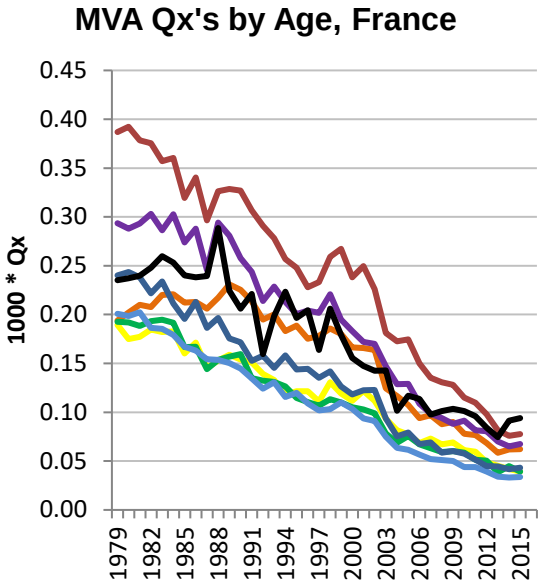


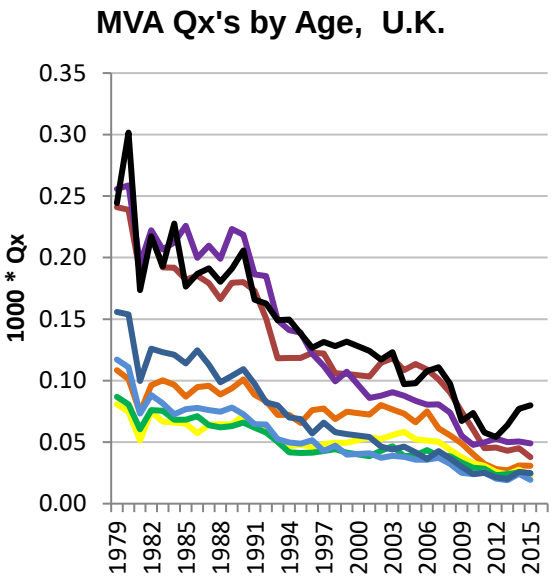
By Age and Country

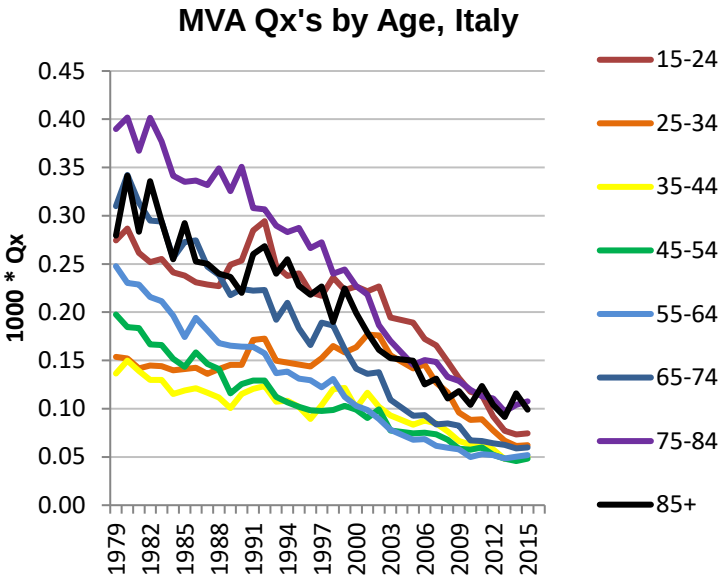
When looking at the MVA deaths by age we see some generalities emerge:

1. This correlation of fall in death rates with historic death rates has driven convergence of absolute MVA mortality rates at each age group.
2. In recent years the highest death rates from MVAs have been in the highest age groups (75-84 and 85+) with the next highest group being the 15-24 band.

These features are most clearly seen in the European countries:

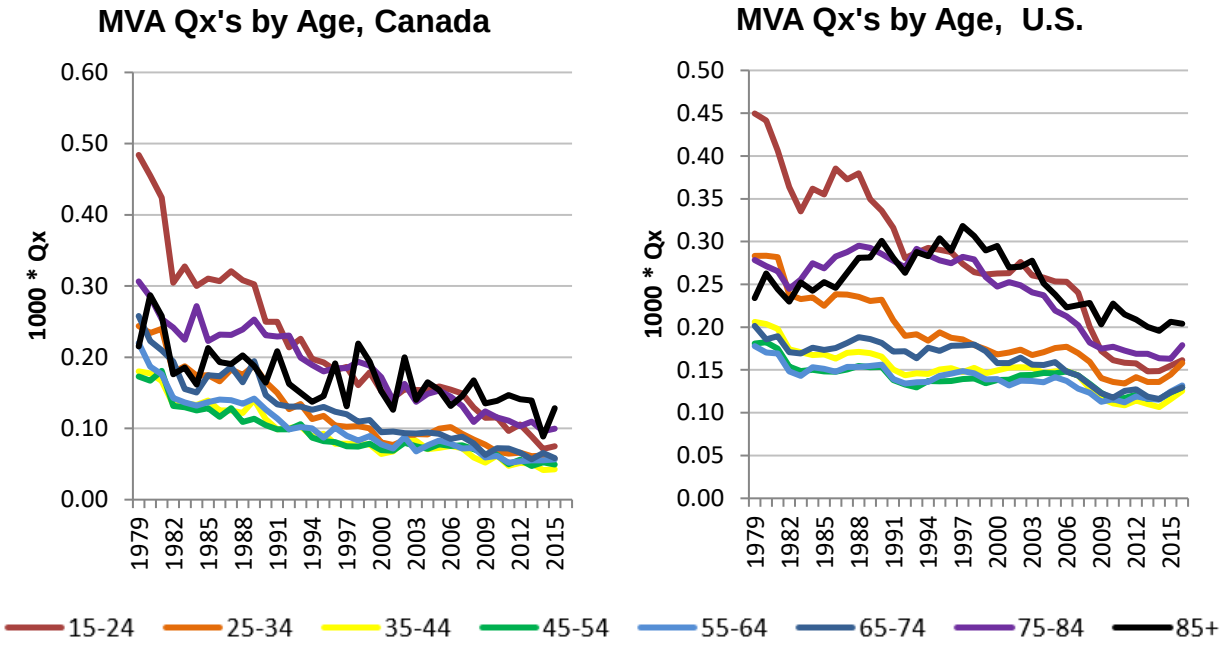




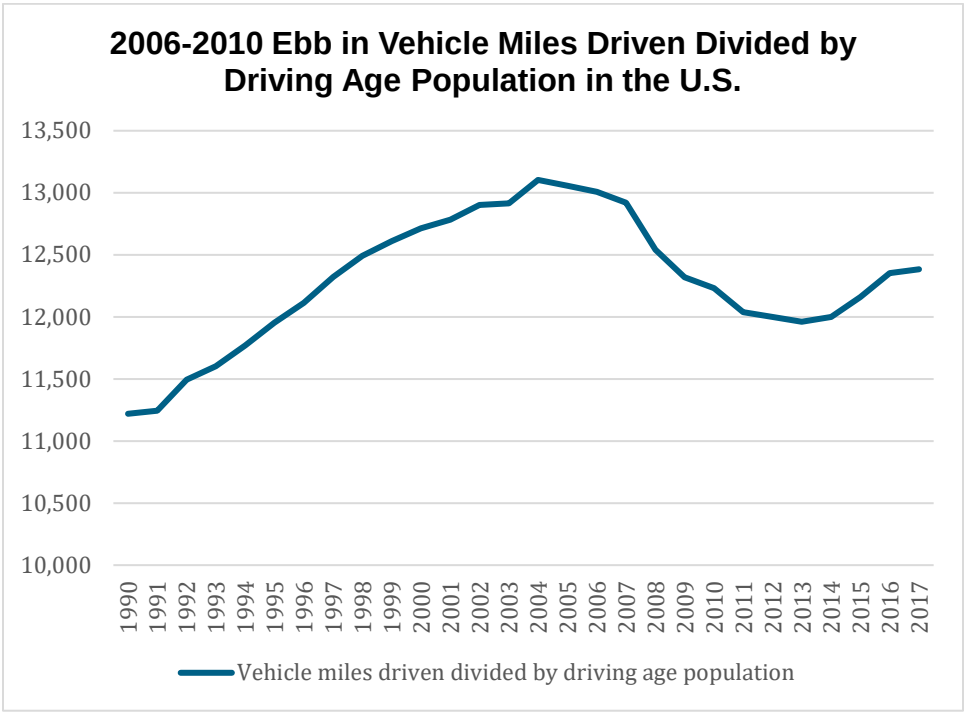


North American countries also demonstrate a number of these trends, but some differences emerge:

- MVA death rates for the two youngest age groups are relatively and absolutely higher in North America than in Europe at the beginning of the period but show significant declines in mortality over the entire period.
- In the U.S. particularly, trends in the oldest age groups were adverse until the early/mid-90s and only started to improve thereafter.



With respect to the U.S. it should be noted that a National Speed Limit was introduced in the mid-70s which led to a significant reduction in MVA deaths. The U.S. saw strong improvement between 2006 and 2009 primarily due to improvements in mortality for the youngest drivers. The improvement may be partially attributed to a decrease in overall motor vehicle usage in that time as shown in the following chart adapted from the Bureau of Transportation Statistics and the Human Mortality Database (Bureau of Transportation Statistcs, 2018), (Human Mortality Database):



Factors Driving Trends

Generally over the period, the effective exposure to risk has increased. The number of road users has increased as has the distance travelled. This exposure to risk would be expected to increase MVA fatality rates per 1,000 of population. The fact that we have seen particularly strong improving trends generally reflects the range of legal and safety measures introduced over the years such as:

- Speed limit changes
- Alcohol and drug restrictions
- Safer road construction (particularly motorways)
- Safer cars (e.g., airbags)
- Better utilization of existing safety equipment, most significantly safety belt use

In more recent years, the improvement trend has slowed in most countries and reversed in a few. Various hypotheses for recent trends have been proposed but it seems likely most influenced by an increase in distracted driving.

For more information on specific measures by country, please refer to the IRTAD report.

Implications for Future Trends

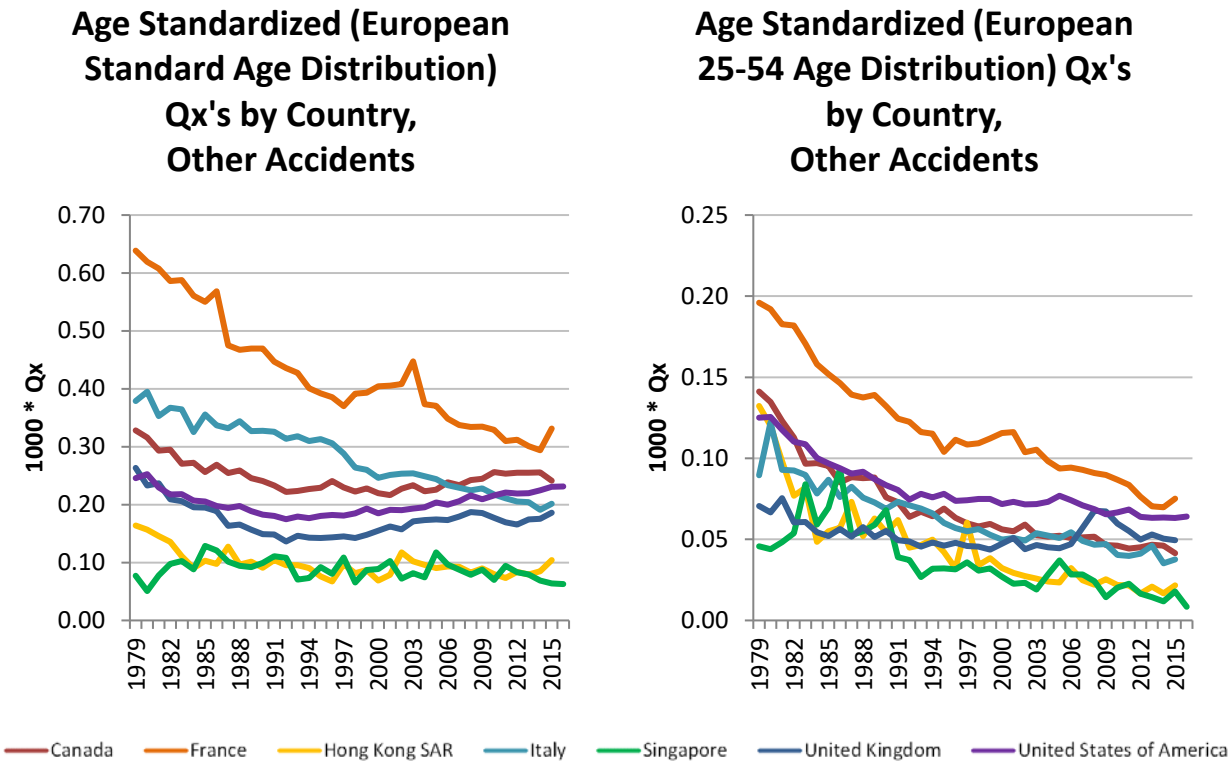
The generally universal fall in MVA mortality rates at all ages would suggest that in time all MVA Qx rates could start to converge at a level similar to the U.K. The U.K.'s MVA mortality rate fall in the late 2000s has carried into more recent years despite our previous view that it could have been artificially depressed due to the reduction in road usage around the economic recession. This would suggest MVA mortality rates of around 3-4 per 100,000 at all ages could be attained in the long-term (at least prior to the introduction of autonomous vehicles).

Other Accidental Deaths

Coding differences between ICD-9 and ICD-10, combined with the WHO system of holding ICD-9 codes at only a grouped level, caused difficulty in correctly categorizing all deaths in this section across all years. Specifically, deaths due to falls are probably inflated while some other deaths that belong in this category are depressed in corresponding years. For details, please refer to the appendix.

By Country

Despite the coding changes, the trends in the Other Accidents category are relatively stable and exhibit a steady continuation of trends that were well established by the time of the coding changes. This suggests our approach of grouping all accidents together has been relatively successful in compensating for the coding change.

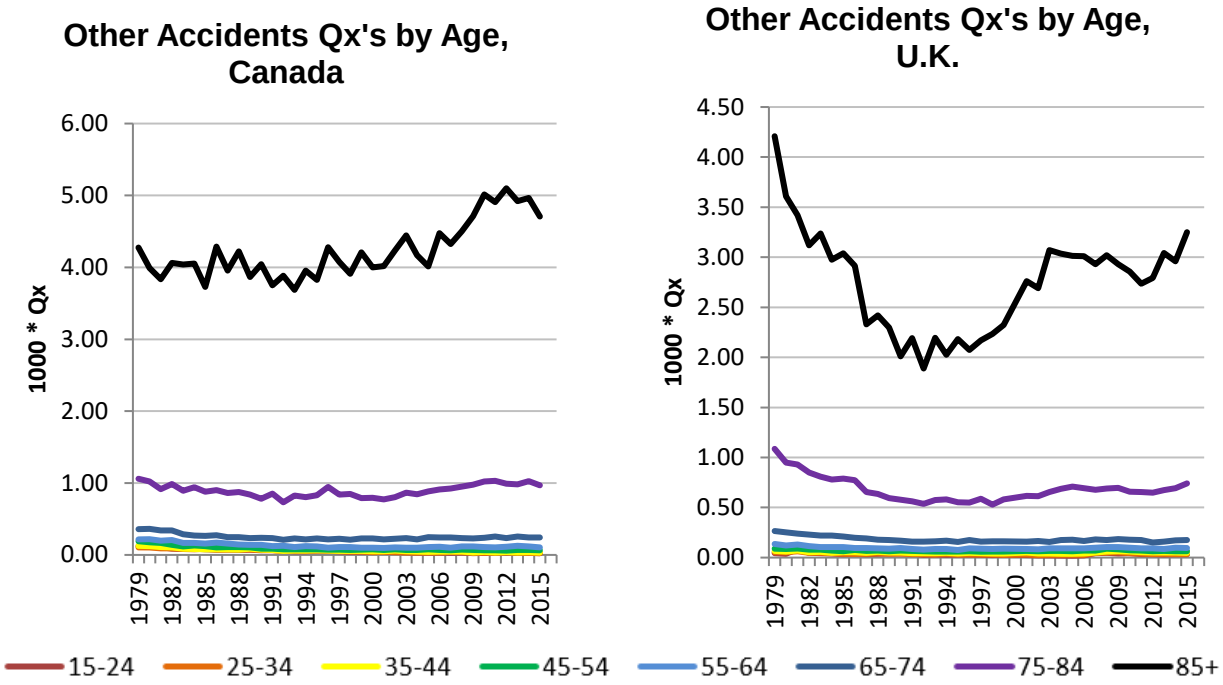


Improvement in the Other Accidents death rate seems to be driving the strong improvement in the overall unnatural death rate in France. Canada, the U.S., and the U.K. have all seen noticeable deterioration in the Other Accidents death rate beginning in the early 1990s.

Restricting the population to ages 25-54 changes the shape of the graph somewhat: The recent deterioration seen in some countries tends to disappear. A general improvement trend emerges across most countries, with the exception of the U.K., along with a gradual slowing of that improvement.

By Age

The three countries that are not demonstrating improvement trends show a strong age-related component, with the oldest ages driving the majority of the deterioration. It is a valid concern when working with such divergent ages that this trend could be partially driven by an aging population within that band. However, calculations based on the U.K. population suggest this would only account for a total increase in Other Accidents mortality rates of between 2% and 4% over a 10-year period. Therefore, we believe this is a true deterioration.



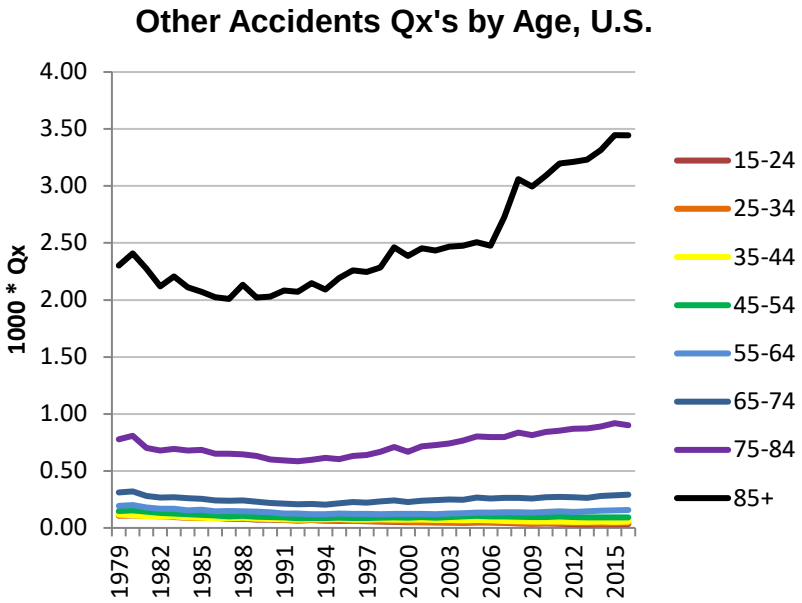
Concentrating on the 85+ age group, Canada's rate has remained stubbornly high over the period whereas the U.K. started at a similar level, fell sharply, then increased again. The U.K. and U.S. both were at a similar level at the beginning of the 1990s and at the end of the 2000s, showing similar levels of deterioration in the intervening period.

The deterioration in the U.S. (Alamqir, Muazzam, & Nasrullah, 2012) and Canada (Chen, Mo, Yi, Jiang, & Mao, 2013) has been noted in academic literature but no definitive explanations have been proposed. A range of suggested reasons include:

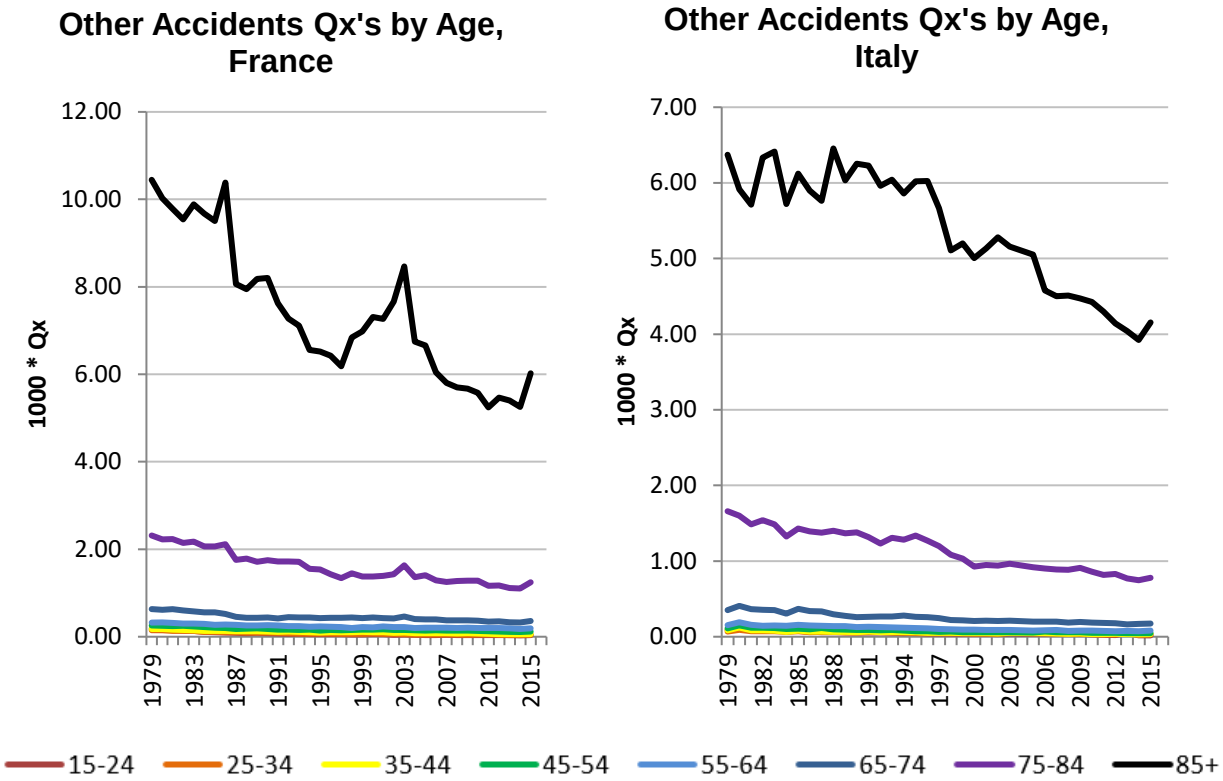
- Health factors, for example obesity and bone mineral density
- Engagement in more physical activities
- Certain medications, especially psychotropics, making falls more likely (Hartikaine, Lönnroos, & K, 2007)

Changing death recording patterns also may have a part to play (Stevens & Rudd, 2014). However, in the U.S. the increase in deaths via Other Accidents has also been accompained by an increase in fall-related hospitalizations (Hartholt, Stevens, Polinder, Cammen, & Patka, 2011).

The U-shaped aspect of accidental fall-related mortality, decreasing through the mid-1990s before increasing, is seen in other countries as well, both in our data and in academic literature – for example, in the Netherlands (Hartholt, Polinder, & al, End of the spectacular decrease in fall-related mortality rate: men are catching up., 2012) – which makes this a global issue.

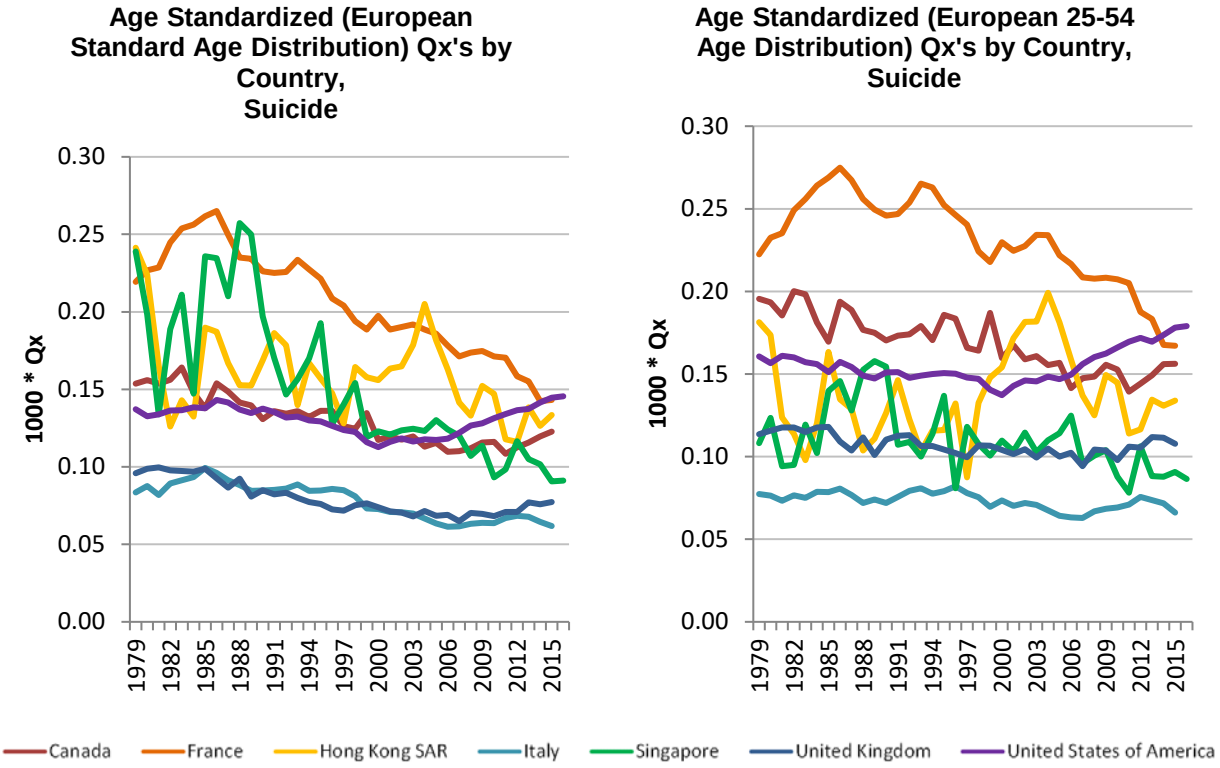


Italy and France have shown improvements among higher age groups but started from a much higher point in the early 1980s, which may have made improvements easier to achieve.


Other Accidents Qx's by Age, France
1000 * Qx
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1979
1983
1987
1991
1995
1999
2003
2007
2011
2015
Other Accidents Qx's by Age, Italy
1000 * Qx
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
15-24
25-34
35-44
45-54
55-64
65-74
75-84
85+

Suicides

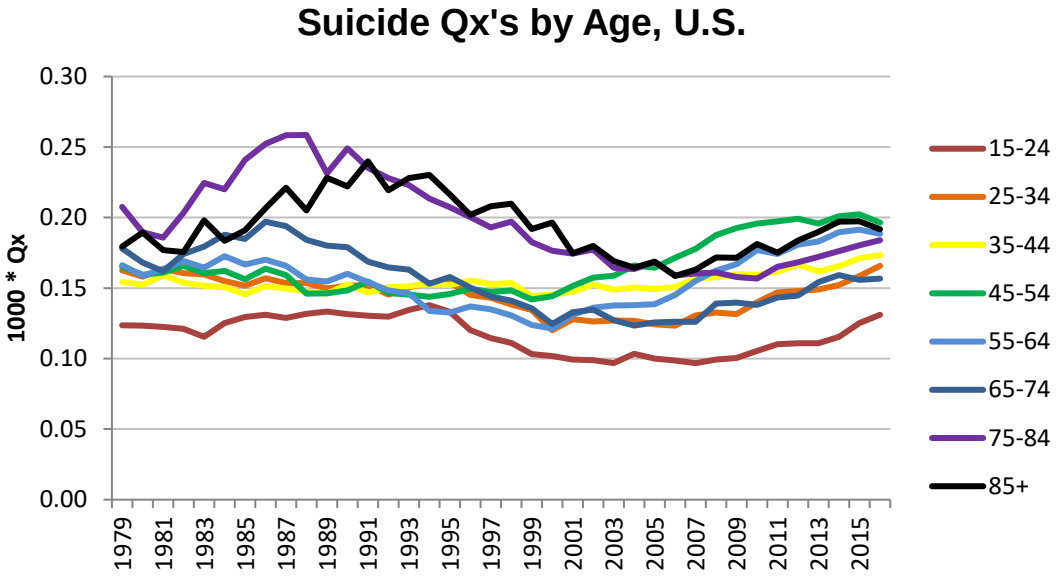
RGA has studied suicide globally many times; notably here, here and here. We do not seek to repeat the detail of those reports but instead simply present the figures produced naturally as part of our work with a brief commentary and note they correspond to the previous findings.



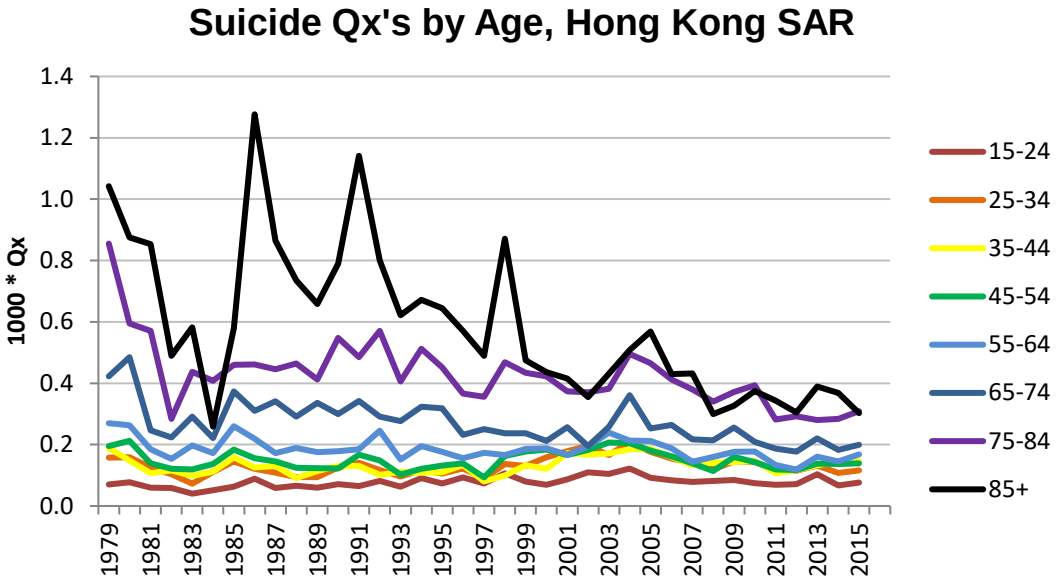
There are three clear strata for suicide mortality which seem to hold for the entire observation period. Suicide rates are relatively low in the U.K. and Italy, while higher suicide mortality is observed in the U.S. and Canada. U.S. rates have significantly deteriorated in the last 15 years. Suicide mortality is high in France, but it has significantly improved in the last 36 years. These trends largely remain when looking at the 25-54 age group.

In the context of Asia, Singapore and Hong Kong SAR are considered low- and medium-risk countries for suicide, respectively, while the high-risk countries of Japan and South Korea have higher suicide mortality rates than France (Chen, Wu, Yousuf, & Yip, 2012).

Suicide experience in the U.S. has consistently deteriorated since 2000. The age analysis below shows that the U.S. deterioration is a problem across age groups.

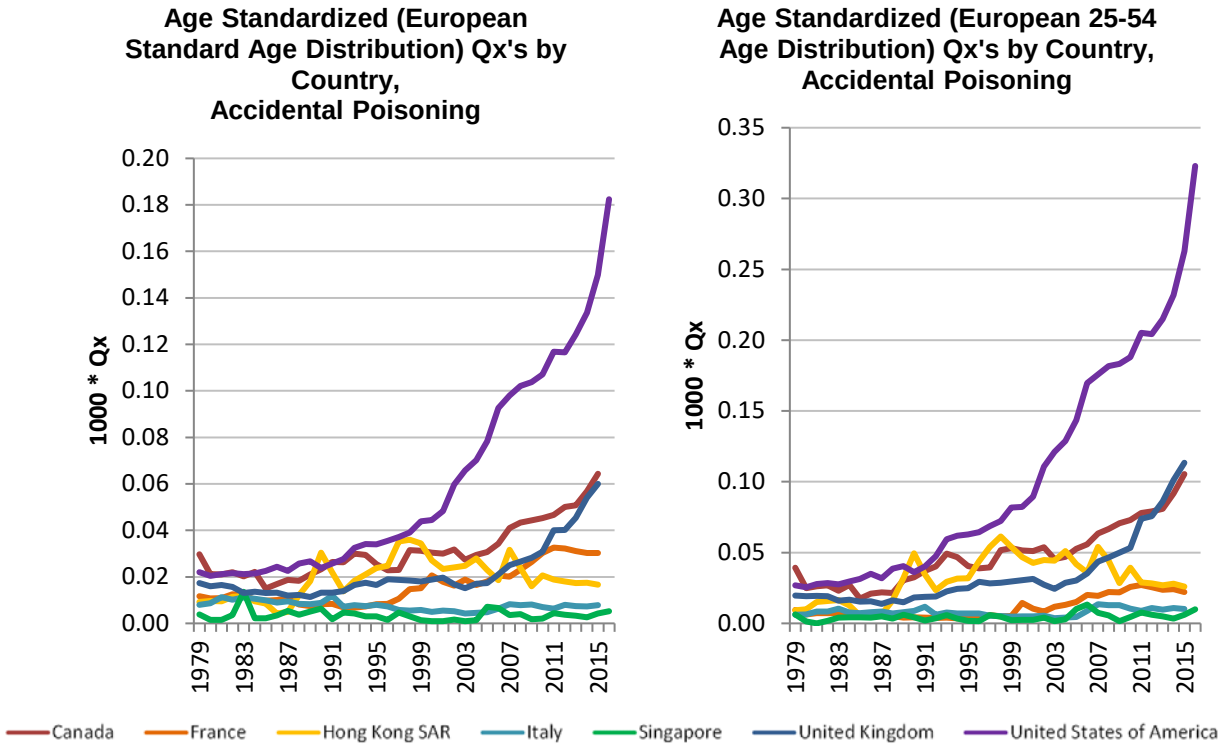


Hong Kong SAR saw a deterioration in experience from 1997 to 2005. This coincides with the Asian Financial Crisis of 1997-1998, and economic recovery beginning in 2004. The trend is consistent across the working age groups (25-54). Similar trends have also been observed in some other Asian countries – Japan and Korea – but not all (e.g., Taiwan and Singapore) (Chang, Gunnell, Sterne, Lu, & Cheng, 2009).



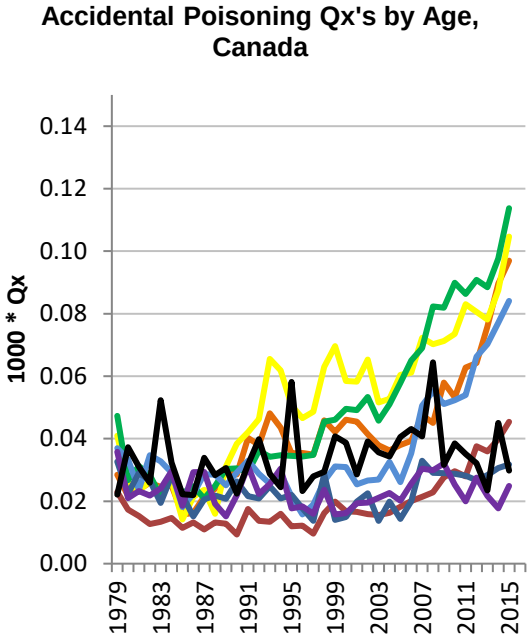
Accidental Poisoning

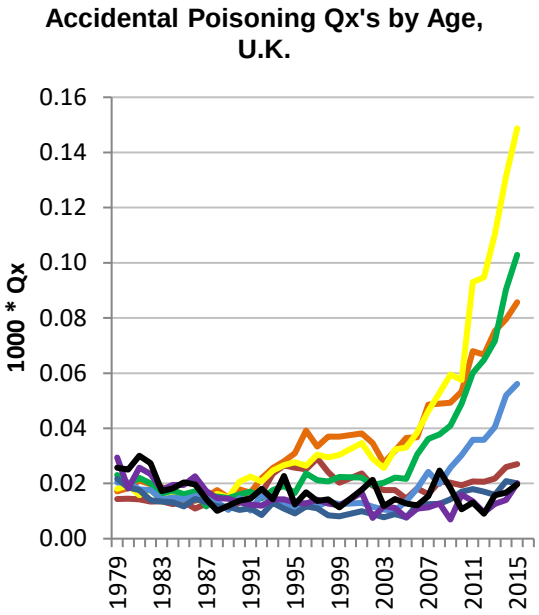
The Accidental Poisoning group does not perfectly align with a drug overdose classification. However, drug overdoses comprise the majority of the deaths in the group and there is much overlap with a typical ICD code classification of drug overdose. Differences and similarities are outlined in the appendix.

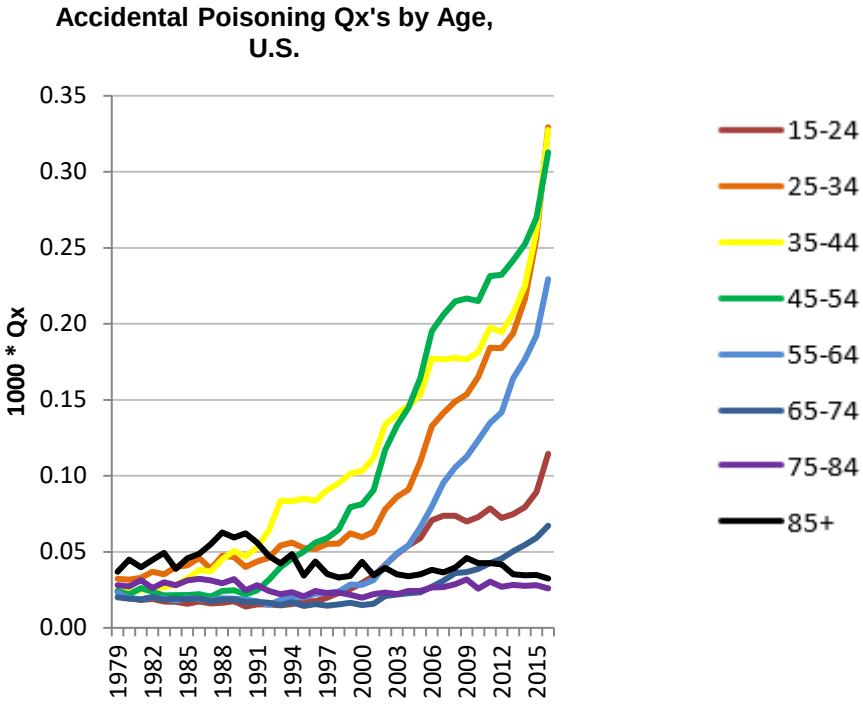


Accidental poisoning can be seen as the primary driver for the recent deterioration in the U.S. Although it has not led to an overall deterioration in the unnatural causes group, the U.K., Canada, and France have also seen substantial deterioration in this category. All other countries have remained relatively flat throughout the period.

Limiting the population to the 25-54 cohort has very little effect on trends but leads to a considerable increase in both the mortality rate and the rate of increase.

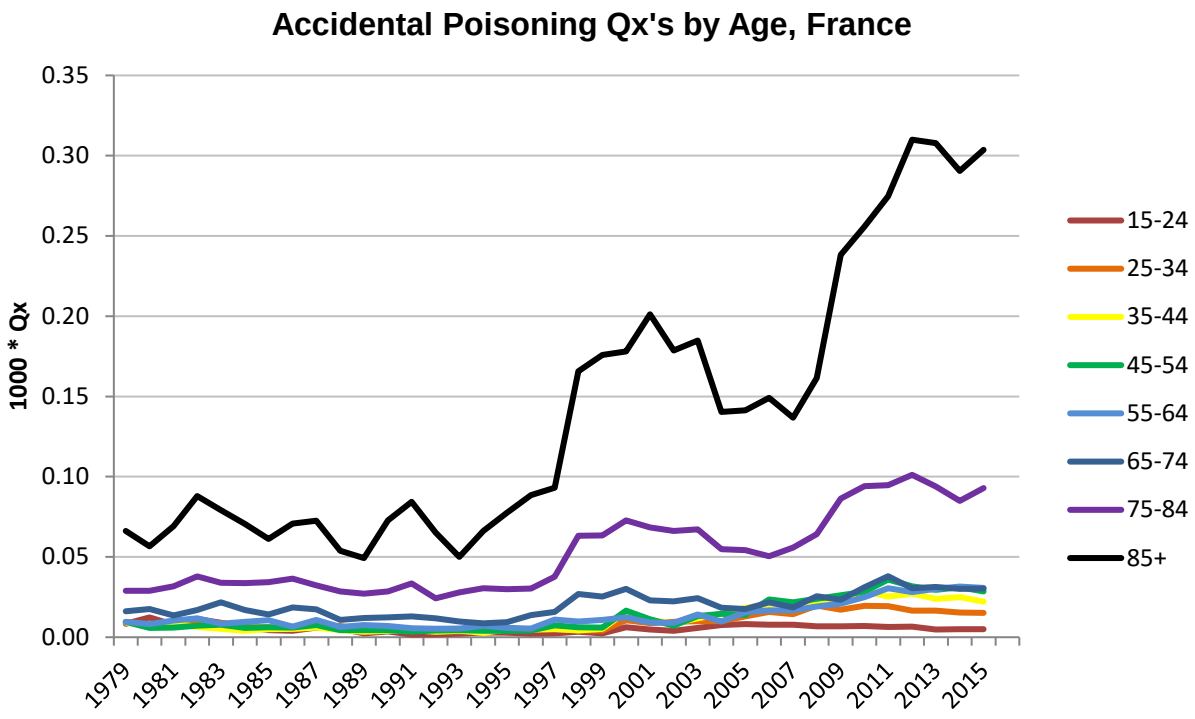




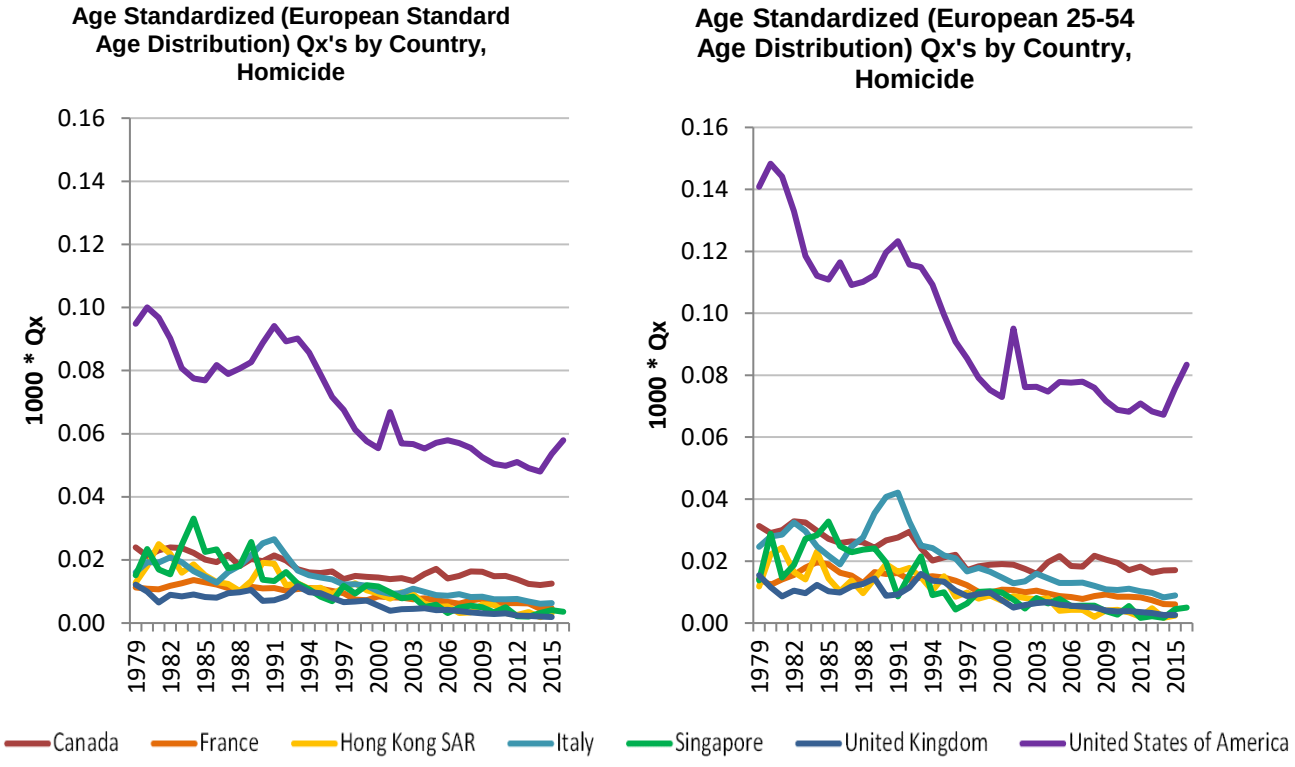


The profound deterioration in experience for Canada, the U.S., and the U.K. is driven by younger and middle-aged cohorts.

France is unique among countries experiencing deterioration due to accidental poisonings, with the heaviest influence coming from the two oldest age groups:



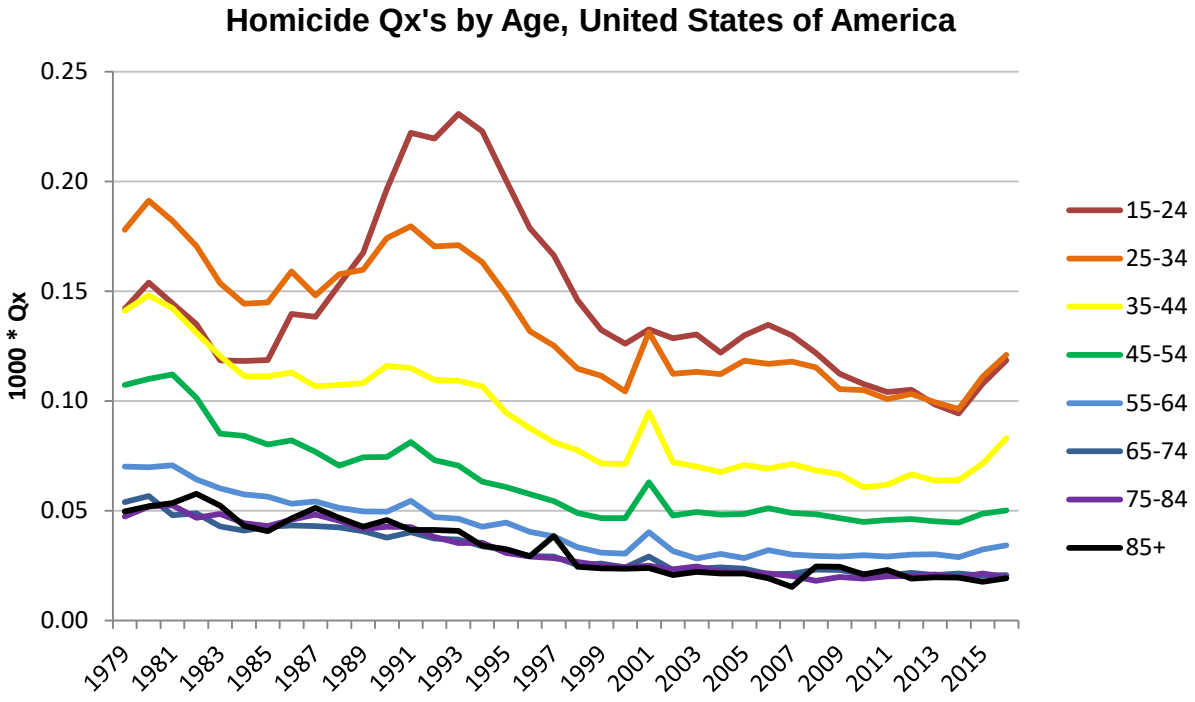
Homicide



GST

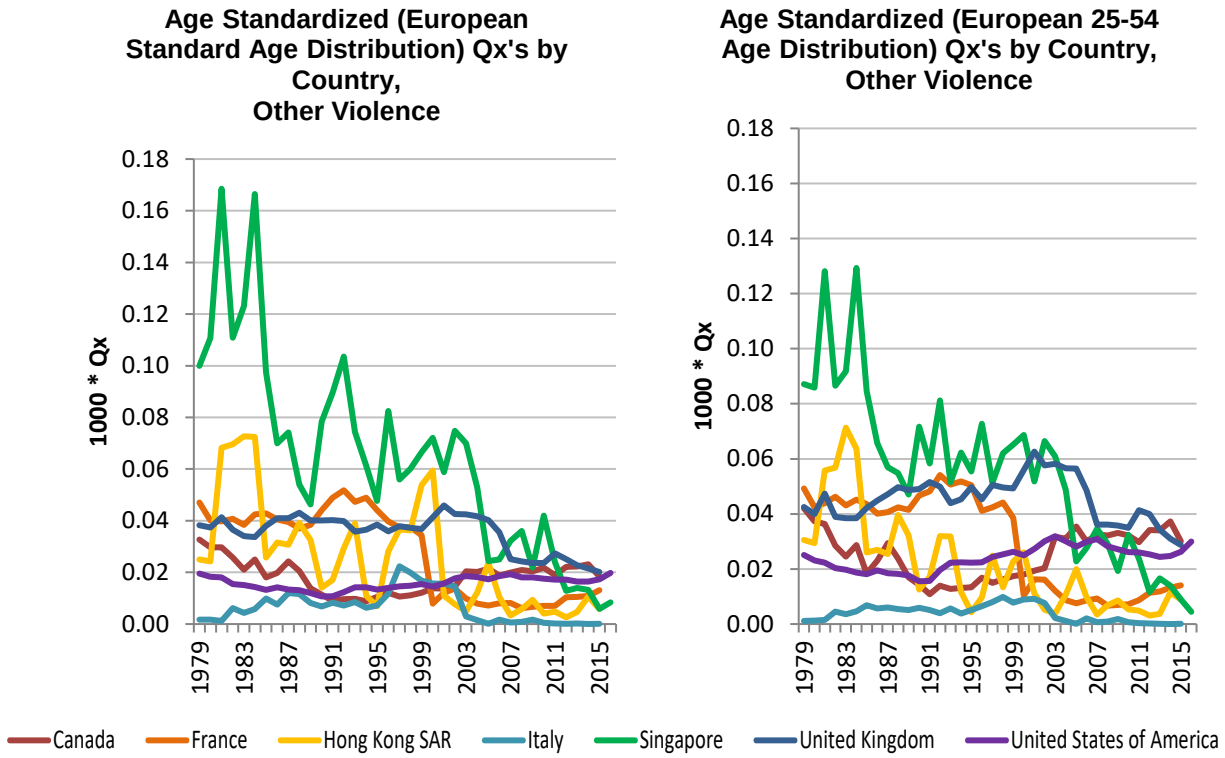
Homicide rates for most countries are fairly similar and generally are not a significant cause of mortality in the context of all causes. The U.S. is a clear outlier here, presumably due to less restrictive firearms regulations, which also impact suicide rates in the U.S. Perhaps reflecting this significant difference in absolute rate, the U.S. has also experienced the strongest improvement in homicide mortality. The temporary spike in 2001 is caused by the September 11th terrorist attacks on the World Trade Center. The U.S. has also seen a spike in homicide mortality in the last two years.

To understand how exceptional the U.S. homicide rates are, consider that in studying 23 countries in this database, only Israel exceeded a per thousand mortality rate of 0.035. This occurred during the period of 2001-2003 when Israeli casualties from the Arab-Israeli conflict peaked (AICE).



Reviewing the U.S. experience by age band, the highest rates have remained for those under 35, and generally decrease as ages increase.

Other Violence



The U.K. and France started out with higher homicide mortality rates, but have seen improvements in recent years, falling more in line with those in the U.S. and Canada. We discount consideration of Singapore and Hong Kong SAR in our interpretation due to limited data volumes.

Appendix 1: ICD Codes

ICD-9 Mapping

Basic Tabulation List	ICD-9 Code	ICD-9 description	Our Allocation
B470	E800-E807	Railway accidents	Other Transport
B471	E810-E819	Motor vehicle traffic accidents	MVA
B472	E826-E829	Other road vehicle accidents	Other Transport
B473	E830-E838	Water transport accidents	Other Transport
B474	E840-E845	Air and space transport accidents	Other Transport
B479	E820-E825	Motor vehicle non-traffic accidents	Other Transport
	E846-E849	Vehicle accidents not elsewhere classifiable	
B48	E850-E869	Accidental poisoning	Accidental Poisoning
B50	E880-E888	Accidental falls	Other Accident
B51	E890-E899	Accidents caused by fire and flames	Other Accident
B52	E900-E929	Other accidents, including late effects	Other Accident
B54	E950-E959	Suicide and self-inflicted injury	Suicide
B55	E960-E969	Homicide and injury purposely inflicted by other persons	Homicide
B56	E970-E999	Other violence	Other Violence

ICD-10 Mapping

Generally speaking, ICD-10 codes are more granular than their ICD-9 counterparts. In order to best preserve data quality and the integrity of the results presented, we chose to convert the ICD-10 codes back to ICD-9 codes. Since the WHO Mortality Database provides data at the Basic Tabulation List (BTL) level for ICD-9, we had to convert the ICD-10 codes in two steps. First, the ICD-10 codes were converted to ICD-9 detail codes using this crosswalk**.** Next, these codes were mapped to the appropriate BTL code (note: one BTL code contains many detail codes, as seen in the table above). This allowed the most consistent categorization of deaths over a study period that spanned years in which ICD-9 was used and years when ICD-10 was used.

MVA Coding Changes

In ICD-10, the vehicle of which the injured person is an occupant is identified in the first two characters since it is seen as the most important factor for prevention purposes. In contrast, the first digits of the ICD-9 code relate to the vehicle and whether or not the incident was traffic-related.

ICD-10 code and name		ICD-9 code and name					
		E800–E807 Railway Accidents	E810–E819 Motor Vehicle Traffic Accidents	E820–E825 Motor Vehicle Non-traffic Accidents	E826–E829 Other Road Vehicle Accidents	Other	Total
V01–V09	Pedestrian injured in transport accident	50	788	32	1	10	871
V10–V19	Pedal cyclist injured in transport accident		138		15	1	154
V20–V29	Motorcycle rider injured in transport accident		489	9		4	502
V30–V39	Occupant of three-wheeled motor vehicle injured in transport accident		2				2
V40–V49	Car occupant injured in transport accident		1,350	17		9	1,376
V50–V59	Occupant of pick-up truck or van injured in transport accident		41			1	42
V60–V69	Occupant of heavy transport vehicle injured in transport accident		44	1			45
V70–V79	Bus occupant injured in transport accident		5	1		1	7
V80–V89	Other land transport accidents	5	95	9	18	18	145
	Other	1	33	4	1		
	Total	56	2,985	73	35	44	

Appendix 2: Mapping Other Accidents

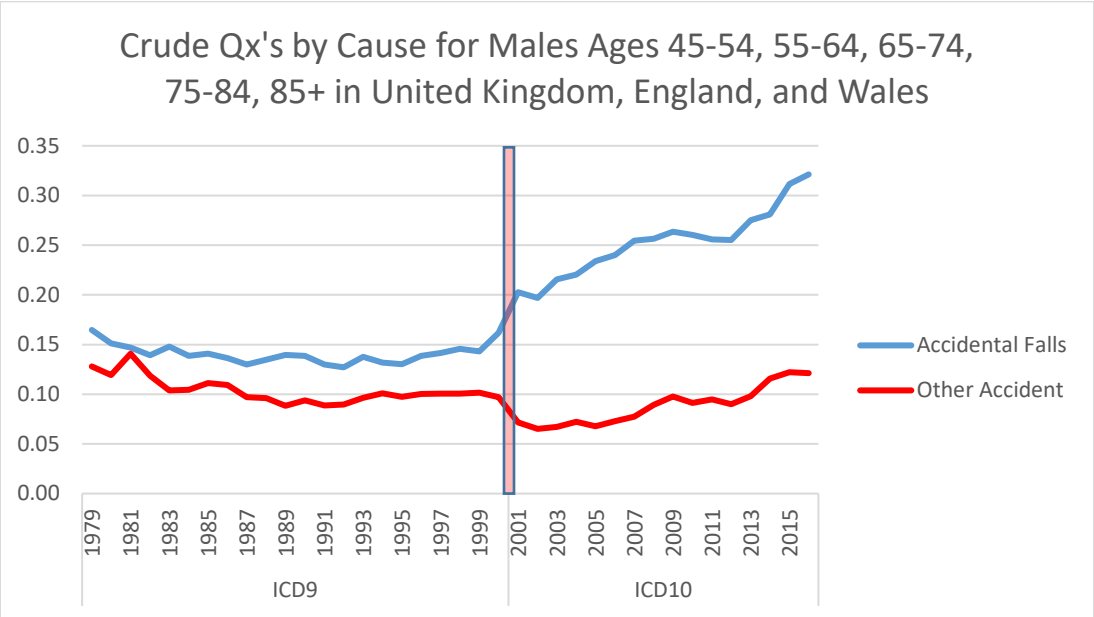
The category Other Accidents was most affected by the change from ICD-9 to ICD-10 during the period. However, by grouping all accidents into one category, we attempted to minimize the impact of the changes.

The biggest issue was with how deaths due to fracture of unspecified cause (E887) were coded. Under ICD-9, it falls under the total for accidental falls deaths (E880-E888); ICD-10 categorizes it as exposure to unspecified factor (X59, and more specifically, X59.0) alongside other deaths where sufficient information was not provided to assign a more specific code (X59.9) (Griffiths & Rooney, 2003).

When looking at deaths from accidental falls in isolation, deaths coded to E887 should be excluded from the ICD-9 analysis, but it was not an option for us since the WHO database only holds ICD-9 codes at a grouped level. Alternatively, a bridge coding could be used.

By grouping together all accidents, we believe the over-allocation of deaths into Accidental Falls (because X59.9 is included) is balanced to some degree by the under-allocation of deaths to Other Accidents. This approach is not perfect. Investigations show that around one-sixth of X59 codes (exposure to unspecified factor causing other and unspecified injury) under ICD-10 would have been allocated to Other Accidents and not E928 (unspecified accident) under ICD-9 (Griffiths & Rooney, 2003).

The graph below, for the U.K., demonstrates the effect of the change on Accidental Falls and Other Accidents separately:



Appendix 3: Mapping Accidental Poisoning

The U.S. Centers for Disease Control and Prevention (CDC) ICD codes that are classified as drug poisoning are listed below. (Prescription Drug Overdose Team, 2013)

Table 2: All Drug Poisoning

	ICD-10 Codes[1]		ICD-9-CM Codes[2]	
Category Intent	**Underlying Cause**	**Contributing Cause**	**Diagnosis**	**External Cause of Injury**
Drug poisoning All intents	X40 X41 X42 X43 X44 X60 X61 X62 X63 X64 X85 Y10 Y11 Y12 Y13 Y14	T36 T37 T38 T39 T40 T41 T42 T43 T44 T45 T46 T47 T48 T49 T50	960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979	E850 E851 E852 E853 E854 E855 E856 E857 E858 E950.0 E950.1 E950.2 E950.3 E950.4 E950.5 E962.0 E980.0 E980.1 E980.2 E980.3 E980.4 E980.5
Drug poisoning Unintentional	X40 X41 X42 X43 X44			E850 E851 E852 E853 E854 E855 E856 E857 E858
Drug poisoning Self-harm/Suicide	X60 X61 X62 X63 X64			E950.0 E950.1 E950.2 E950.3 E950.4 E950.5
Drug poisoning Assault/ Homicide	X85			E962.0
Drug poisoning Legal intervention or operation of war	-			-
Drug poisoning Undetermined Intent	Y10 Y11 Y12 Y13 Y14			E980.0 E980.1 E980.2 E980.3 E980.4 E980.5

[1] For ICD-10, the death must have an underlying cause code from among those shown. Contributing cause codes can then be used to indicate the specific type(s) of drug involved but do not specify intent.

[2] For ICD-9-CM, the event can have either an N code listed in the Diagnosis column OR an E code listed in the External Cause of Injury column. Only E codes specify intent.

This system is evidently not a perfect match with the ICD-9 codes for Accidental Poisoning in the Basic Tabulation List (shown in Appendix 1), but there appears to be much overlap.

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