**ORIGINAL RESEARCH** Cohort study

# Going home for Christmas: the risks for inpatients

L Lapointe-Shaw, PC Austin, NM Ivers, J Luo, DA Redelmeier, CM Bell

**Objective** To determine whether patients discharged from hospital during the December holiday period have fewer outpatient follow-ups and higher rates of death or readmission than patients discharged at other times.

**Design** Population based retrospective cohort study.

**Setting** Acute care hospitals in Ontario, Canada, 1 April 2002 to 31 January 2016.

**Participants** 217 305 children and adults discharged home after an urgent admission, during the two week December holiday period, compared with 453 641 children and adults discharged during two control periods in late November and January.

**Main outcome measures** The primary outcome was death or readmission, defined as a visit to an emergency department or urgent rehospitalisation, within 30 days. Secondary outcomes were death or readmission and outpatient follow-up with a physician within seven and 14 days after discharge. Multivariable logistic regression with generalised estimating equations was used to adjust for characteristics of patients, admissions, and hospital.

**Results** 217 305 (32.4%) patients discharged during the holiday period and 453 641 (67.6%) discharged during control periods had similar baseline characteristics and previous healthcare utilisation. Patients who were discharged during the holiday period were less likely to have follow-up with a physician within seven days (36.3% *v* 47.8%, adjusted odds ratio 0.61, 95% confidence interval 0.60 to 0.62) and 14 days (59.5% *v* 68.7%, 0.65, 0.64 to 0.66) after discharge. Patients discharged during the holiday period were also at higher risk of 30 day death or readmission (25.9% *v* 24.7%, 1.09, 1.07 to 1.10). This relative increase was also seen at seven days (13.2% *v* 11.7%, 1.16, 1.14 to 1.18) and 14 days (18.6% *v* 17.0%, 1.14, 1.12 to 1.15). Per 100 000 patients, there were 2999 fewer follow-up appointments within 14 days, 26 excess deaths, 188 excess hospital admissions, and 483 excess emergency department visits attributable to hospital discharge during the holiday period.

**Conclusions** Patients discharged from hospital during the December holiday period are less likely to have prompt outpatient follow-up and are at higher risk of death or readmission within 30 days.

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Cite this as: *BMJ* 2018;363:k4481

Find the full version with references at http://dx.doi.org/10.1136/bmj.k4481

**WHAT IS ALREADY KNOWN ON THIS TOPIC**

- Many studies have found that patients admitted to hospital during off-hours are at increased risk of in-hospital mortality
- Some studies have found that patients discharged from hospital on Fridays or at weekends are at increased risk of readmission
- The outcomes of patients discharged during the December holiday period have not been described

**WHAT THIS STUDY ADDS**

- Patients discharged during the December holiday period have an increased risk of death or readmission within 7, 14, and 30 days
- Patients discharged during the holiday period are also less likely to have an outpatient follow-up visit with a physician within seven or 14 days of discharge
- The baseline characteristics of patients discharged during the holiday period did not differ meaningfully from those discharged during control periods

## Introduction

The Christmas holiday is characterised by festivities, social commitments, and synchronised time off work for parents with school aged children. Studies of the "weekend effect" have described increased mortality in patients admitted to hospital on weekends compared with weekdays.[12-14] The comparatively few studies examining the effect of timing of hospital discharge on patient outcomes have reported mixed results.[18-22] Patients discharged at weekends tend to be younger, have fewer comorbidities, and have shorter lengths of hospital stay than patients discharged on weekdays.[20 22 23]

We hypothesised that the December holiday period is a vulnerable time for patients discharged from hospital, as reduced staffing levels could affect coordination of care and access to follow-up. We tested whether patients discharged from hospital during the holiday period were at greater risk of death or readmission than patients discharged at other times. In addition, we compared follow-up with a physician in these two groups.

## Methods

We conducted a population based retrospective cohort study of patients discharged from acute care hospitals between 1 April 2002 and 31 January 2016, in Ontario, Canada. (See full paper on bmj.com for inclusion and exclusion criteria.) The two week December holiday, which comprises Christmas Day and New Year's Day, was compared with two winter time control periods in late November and January.

The primary outcome was a composite of death or readmission within 30 days of hospital discharge. Readmission was defined as either an emergency department visit or an urgent rehospitalisation. Secondary outcomes were outpatient follow-up with any physician within seven and 14 days of hospital discharge. We also reported death or readmission within seven and 14 days, as well as death, urgent rehospitalisation, or visit to an emergency department within 7, 14, and 30 days of discharge.

### Statistical analysis

We compared patients discharged during the December holiday with those discharged during the control periods. For illustrative purposes, we plotted time to death or readmission using a Kaplan-Meier curve. For all outcome comparisons we report unadjusted and adjusted odds ratios (95% confidence intervals).

To evaluate the temporal relation between Christmas Day and short term outcomes we plotted the proportion of patients experiencing each seven day outcome according to their day of discharge, for 30 days before to 30 days after Christmas Day.

| Patient group | No (%) Holiday period | No (%) Control period | Odds ratio (95% CI) |
|---|---|---|---|
| **Period of discharge** | | | |
| 2002-08 | 28 660 (25.6) | 57 042 (24.3) | 1.08 (1.06 to 1.09) |
| 2009-16 | 27 593 (26.2) | 54 887 (25.1) | 1.06 (1.04 to 1.07) |
| **Patient age (years)** | | | |
| <18 | 6184 (20.5) | 12 573 (20.0) | 1.03 (1.00 to 1.07) |
| 18-64 | 25 549 (26.4) | 50 651 (24.5) | 1.10 (1.08 to 1.12) |
| ≥65 | 24 520 (27.2) | 48 705 (26.5) | 1.04 (1.02 to 1.06) |
| **Sex** | | | |
| Female | 27 579 (25.7) | 55 751 (24.4) | 1.07 (1.05 to 1.09) |
| Male | 28 674 (26.1) | 56 178 (24.9) | 1.06 (1.05 to 1.08) |
| **Type of residence** | | | |
| Rural | 10 061 (31.4) | 20 140 (29.3) | 1.11 (1.08 to 1.14) |
| Not rural | 46 192 (24.9) | 91 789 (23.9) | 1.06 (1.05 to 1.07) |
| **Income fifth** | | | |
| 1st (lowest) | 13 652 (27.6) | 27 385 (26.4) | 1.06 (1.04 to 1.09) |
| 2nd | 11 685 (25.7) | 23 759 (25.1) | 1.03 (1.01 to 1.06) |
| 3rd | 10 741 (25.6) | 21 356 (24.2) | 1.08 (1.05 to 1.11) |
| 4th | 10 367 (24.9) | 20 369 (23.7) | 1.07 (1.04 to 1.10) |
| 5th (highest) | 9493 (25.3) | 18 359 (23.4) | 1.11 (1.08 to 1.14) |
| **Length of hospital stay (days)** | | | |
| 0-3 | 28 771 (24.2) | 52 485 (22.6) | 1.09 (1.08 to 1.11) |
| >3 | 27 482 (27.9) | 59 444 (26.8) | 1.06 (1.04 to 1.07) |
| **Method of arrival at index admission** | | | |
| Ambulance | 19 016 (26.8) | 37 180 (26.2) | 1.02 (1.01 to 1.05) |
| Not ambulance | 37 237 (25.5) | 74 749 (24.0) | 1.08 (1.07 to 1.10) |
| **Charlson comorbidity index score** | | | |
| 0 | 26 065 (22.9) | 51 131 (21.3) | 1.10 (1.08 to 1.11) |
| 1 | 10 210 (23.5) | 19 685 (22.7) | 1.04 (1.02 to 1.07) |
| 2 | 7229 (29.2) | 14 752 (28.4) | 1.04 (1.01 to 1.08) |
| 3 | 4430 (31.2) | 8921 (30.0) | 1.06 (1.02 to 1.11) |
| ≥4 | 8319 (39.6) | 17 440 (38.6) | 1.04 (1.01 to 1.08) |

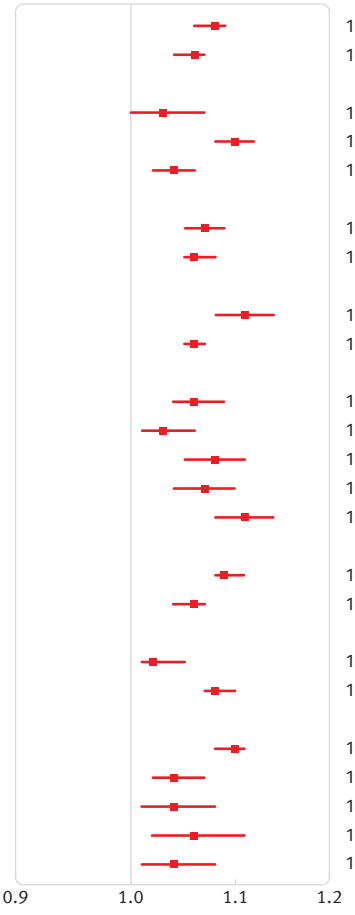


**Fig 2 | Forest plot of unadjusted results for 30 day death or readmission after hospital discharge during the Christmas holiday period or two controls periods, stratified by baseline patient and hospital characteristics (see appendix figure 2 for detailed graphic)**

Patients discharged during the holiday period were at increased risk of death or readmission within 30 days. No group—children, adults and older adults—showed a statistically significant decreased risk

## Results

Of 670 946 eligible participants, 93 092 (13.9%) were children, 303 579 (45.3%) were adults aged <65, and 274 275 (40.9%) were older adults. Overall, 217 305 (32.4%) patients were discharged during the December holiday period and 453 641 (67.6%) during the two control periods. Patients discharged during the holiday period were similar to those discharged during the control periods (table 1, see bmj.com).

### Follow-up with a doctor, death, or readmission

Patients discharged during the holiday period were less likely to have follow-up with a doctor within seven days (36.3% *v* 47.8%, adjusted odds ratio 0.61, 95% confidence interval 0.60 to 0.62) and 14 days (59.5% *v* 68.7%, 0.65, 0.64 to 0.66). Per 100 000 patients, there were 2999 fewer follow-ups within 14 days attributable to discharge during the holiday period.

Time to death or readmission differed between patients in the holiday period group and control periods group (log-rank test P<0.001, fig 1, see bmj.com). Patients discharged during the holiday period were at increased risk of death or readmission within 30 days (25.9% v 24.7%, 1.09, 1.07 to 1.10). This was explained by an increased risk of return to the emergency department (24.3% v 23.0%, 1.09, 1.07 to 1.10), rehospitalisation (11.8% v 11.4%, 1.06, 1.04 to 1.08), and death (1.5% v 1.5%, 1.06, 1.02 to 1.10) within 30 days (table 2, see bmj.com).

The increased unadjusted risk of 30 day death or readmission was observed across many patient characteristics, and no group showed a statistically significant decreased risk (fig 2). Overall, per 100 000 patients there were 26 excess deaths, 188 excess rehospitalisations, and 483 excess visits to an emergency department attributable to being discharged from hospital during the holiday period.

### Analysis of "Christmas effect"

Patients discharged during the week before or week after Christmas Day were less likely to have follow-up within seven days (33.6% v 47.6%, odds ratio 0.56, 95% confidence interval 0.55 to 0.56) than those discharged before or after this period (fig 3 see bmj.com). Patients discharged during the week before or the week after Christmas Day were at higher risk of death or readmission within seven days (14.2% v12.4%, 1.17, 1.15 to 1.18) than those discharged before or after this period.

## Discussion

Several possible mechanisms might explain how the December holiday period could lead to decreased follow-up. Firstly, the holiday period might be a time of reduced access to outpatient care. Patients might not be able to contact their physician or could encounter difficulties in booking appointments. Secondly, patients might prefer to postpone their follow-up visit until their usual physician is available, or until the end of the holiday festivities or travel commitments. Thirdly, hospital based coordination of follow-up care might be reduced over the holidays, with staffing reductions mirroring those in outpatient clinics.

The relation between discharge from hospital during the holiday period and death or readmission might also be explained in several ways. Firstly, for many the December holiday is filled with festive activities and potential physiological stressors (eg, tense interpersonal exchanges, lack of sleep, increased intake of alcohol, sodium, and sugar). These altered circumstances could destabilise an acute medical condition. Secondly, concerned family members on holiday leave may encourage an earlier return to the emergency department. Yet, the increased risk of readmission and death observed in our study suggests that such visits are not limited to minor conditions. Thirdly, decreased follow-up, as found in our study, could reduce the chance of identifying avoidable complications or early deterioration.

### Limitations of this study

Although length of hospital stay, comorbidities, and previous attendance at an emergency department are known predictors of post-discharge outcomes,[35 40] they are imperfect proxies for more detailed clinical information on severity of illness. Thus, the possibility of confounding due to unmeasured differences remains. In addition, our finding of a decrease in outpatient follow-up among patients discharged during the holiday period might not be generalisable to all populations. In particular, follow-up rates can be expected to vary according to local community practices.

More detailed information on patient severity of illness would strengthen the argument for causation between discharge during the holiday period and health outcomes. Further study of the potential role of follow-up in mediating this relation is now justified. Rather than rushing to get patients home, hospital clinicians should pay attention to discharge planning for this vulnerable group, ensuring optimal patient education, drug review, and follow-up care. Discharged patients, unlike unwanted gifts, should not be returned after the holidays.

# Live happily ever after with a fairy tale to clinical coding

With the rollout of a new coding system in the UK under way, **Richard Williams** reveals a lighter side to recording data

**Sleigh bells ring, are you listening? Read codes fade, SNOMED's glistening**

If you didn't find the section heading amusing you either have no sense of humour (SNOMED: 288801003—"Unable to use humour"), you don't know any Christmas songs (SNOMED: 16170002—"Music blindness"), or, like most normal people, you don't know much about clinical coding.

In a nutshell, coding is the use of short alphanumeric codes to record symptoms, diagnoses, laboratory tests, procedures, and medicines in the electronic health record. For example, a GP in UK primary care might enter "C10F" to record a diagnosis of type 2 diabetes, "22A" along with a value and a unit to record a person's weight, "di1m" to record a prescription of 300 mg soluble aspirin tablets, or "T550" for spacecraft launch pad accidents (more on this later). Typically, a clinician starts typing and the medical record software suggests appropriate codes from a dropdown list.

Collectively, these codes are called either dictionaries (because each code has a definition) or terminologies. C10F, 229, and di1m are all examples of Read codes, which were created in the 1980s by James Read for use in primary care. Read codes have been the main clinical coding system in UK primary care since the mid-1990s.[1]

### Accuracy and reliability

Using clinical codes provides a level of standardisation that's incredibly useful for continuity of care, monitoring safety, and improving quality.

Accurate and specific coding also greatly benefits researchers, who can then analyse patient data to identify patterns and make predictions. It's not always positive, however, as tension can arise between the needs of clinicians looking for small sets of codes that are clinically relevant to their area of medicine and terminologies that aim to comprehensively cover all aspects of healthcare.

**And since we've no more Read code, let it SNO, let it SNO, let it SNO(MED)**

SNOMED is another terminology, one that is internationally recognised and used in more than 50 countries. Unlike Read, SNOMED codes are entirely numeric. The UK government recently decided that the NHS would migrate all clinical systems to use SNOMED by 2020, with primary care the first to migrate. Having just one terminology, instead of many, will hopefully increase the accuracy and reliability of the data exchanged between care settings, to enable better reporting and analysis.

Should auld code sets be forgot and never brought to mind? Certainly not. In this season of reflection it seems topical and timely to look back at Read code and look ahead to the transition to the new system—not only because Read code has played such a big part in primary care over the past two decades but also because "SNOMED" sounds a lot like "snowmen."

**Codes for falling, all around me, GPs coding, having fun**

The Read code dictionary is immense. I'm sure that all GPs remember the first time they treated a child who had gone to school only to fall off a cliff and thought, "There's a code for that!" (U10F200: fall from cliff; occurrence at school) or the first time they had to deal with farm based ice skating injuries (U102700: fall involving ice skates, skis, roller skates, or skateboards; occurrence on farm). Falls are a big problem, and Read codes offer various options beyond the common occurrence of frail elderly people falling in their own homes, such as falling from a turret (TC25.00), a haystack (TC4y100), or a flagpole (TC23.00).

You can fall "in an aircraft" (T532.00) or "from an aircraft" (T534.00). I know which one I'd prefer. But you can also fall "on an aircraft" (T533.00), which I

assume means falling from something else (also coded, perhaps) and then landing on a plane. Finally, for absolute completeness, there's a catch-all code in the form of T53z.00: "Fall in, on, or from aircraft not otherwise specified."

Read codes are a dream come true for a stuntman's doctor. You can fall from a cable car (T613.00) or from a moving vehicle (T183.00) into a dock, pit, or storm drain (TC3y100, TC3y300, TC32100)—and, more spectacularly, from a burning apartment, a burning camping place, a burning boarding house, a burning tenement, a burning barn, a burning church, a burning factory, a burning hospital, a burning school, or a burning mobile home (TD07).

Almost every incident represented by a code has probably happened to someone somewhere but, without wishing to diminish their suffering or indeed death, is it clinically useful to know whether people who have drowned did so when a boat overturned (T400.00), sank (T401.00), or was crushed (T404.00)—or that they fell (T402.00) or jumped (T403.00) from said boat because it was on fire?

### Superfluous terms

The odd "Easter egg" is harmless, but there are 523 Read codes for falls, 1480 for motor vehicle traffic incidents, 459 for motor vehicle NON-traffic incidents, and 1104 for air, sea, and train incidents. Together these represent a significant proportion of the entire dictionary, and their inclusion is a small but cumulatively significant drain on clinicians' time while searching for codes that are actually useful.

Don't worry if you're a GP who regularly uses these codes. As SNOMED drew extensively on Read codes during its creation, they're all still available in the new dictionary. Fortunately, SNOMED codes (unlike Read codes) can be marked as inactive to remove superfluous terms. One hopes that SNOMED's creators pursue this actively and ruthlessly.

## Look to the future now, it's only just begun

It's a laudable aim to have a single code dictionary across all parts of the NHS, and this may well lead to the promised improvements. It may, however, have unintended consequences: at almost five times the size of Read, SNOMED has the potential to lengthen the time GPs take to code patient interactions.

Everyone involved in healthcare stands to gain from well coded data. The quality of coding in primary care increased after the implementation of the Quality and Outcomes Framework.[3] This would indicate barriers to good coding, and it seems to have taken an obvious and quantifiable incentive (in this case, financial) to improve matters. I suspect that most GPs would prefer simply to type brief notes during a consultation than to undertake the laborious and error prone task of identifying the correct clinical codes.

But why not have the best of both worlds? Natural language processing—the ability for computers to process text intelligently—is not ready to replace manual coding, but it's already sufficiently advanced to analyse a written note and suggest codes that accurately reflect the encounter.[4] And why stop there? Speech recognition, combined with natural language processing, could generate a transcript of a conversation between a GP and a patient so that, by the time GPs turn to their computers, they would have a summary of the encounter plus possible diagnoses, a range of appropriate medicines, and suggested next steps. ("The robot will see you now . . .")

### Delivering the goods

After the migration to SNOMED, without improvements to existing IT systems the extra moments spent searching through an even longer list of irrelevant codes generated by each search will increase the burden on clinicians, who are already under tremendous time pressure. It's essential that barriers to good coding are identified and removed, whether through training, IT improvements, or wholesale reform of the code dictionary.[5] Research is urgently needed on the design of such systems, their usability in practice, and whether SNOMED is in fact delivering the goods in a real world setting.

What, then, does the future hold for clinical code terminologies, GPs, and the NHS in general? God only knows (Read: R2yz.11; SNOMED: 301327002).

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Cite this as: *BMJ* 2018;363:k5209

It's beginning to look a lot like . . . quiz time
It wouldn't be Christmas without a pantomime, so see if you can guess the following patients from the meticulously coded casebook of the Doctors Grimm

*Once upon a time there was a female baby (634..12). Black magic and Wiccan (13y8.00 and 13yD.00). Puberty (ZV21100). Accident caused by spinning machine (TG3y500), excessive sleep (1BX1.00). Contact with plant thorns and spines and sharp leaves occurrence at other specified place (V12Ay00), concussion with more that 24 hours' loss of consciousness and (S603.00) manual resuscitation (8731.00) then return to pre-existing conscious level (S603.00). Married (1332.00).*

*Once upon a time there was a female baby (634..12), lives with biological parent and step parent (131Z.100). Stepsister (9d31.00), stepsister (9d31.00). Victim of domestic servitude (14XN.00), neglected appearance (222R.00), Wiccan (13yD.00), patient's condition improved (2126.00). Accidentally struck by thrown ball (TG10500). Patient too late (9N43.00), patient walked out (9N45.00), restless sleep (E274D11), brief depressive reaction (E290), fitting or adjustment of orthopaedic shoes (ZV53714). Married (1332.00).*

Answers: *Sleeping Beauty* and *Cinderella*

**ORIGINAL RESEARCH**
SWEDEHEART observational study 1998-2013

# Christmas, holidays, and sport as triggers of acute myocardial infarction

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**Objectives** To study circadian rhythm aspects, national holidays, and major sports events as triggers of myocardial infarction.

**Design** Retrospective observational study using the nationwide coronary care unit registry, SWEDEHEART.

**Setting** Sweden.

**Participants** 283 014 cases of myocardial infarction reported to SWEDEHEART between 1998 and 2013. Symptom onset date was documented for all cases, and time to the nearest minute for 88%.

**Interventions** Myocardial infarctions with symptom onset on Christmas/New Year, Easter, and Midsummer holiday were identified. Similarly, myocardial infarctions that occurred during a FIFA World Cup, UEFA European Championship, and winter and summer Olympic Games were identified. The two weeks before and after a holiday were set as a control period, and for sports events the control period was set to the same time one year before and after the tournament. Circadian and circaseptan analyses were performed with Sunday and 12 am as the reference day and hour with which all other days and hours were compared. Incidence rate ratios were calculated using a count regression model.

**Main outcome measures** Daily count of myocardial infarction.

**Results** Christmas and Midsummer holidays were associated with a higher risk of myocardial infarction (incidence rate ratio 1.15, 95% confidence interval 1.12 to 1.19, P<0.001, and 1.12, 1.07 to 1.18, P<0.001, respectively). The highest associated risk was observed for Christmas Eve (1.37, 1.29 to 1.46, P<0.001). No increased risk was observed during Easter holiday or sports events. A circaseptan and circadian variation in the risk of myocardial infarction was observed, with higher risk during early mornings and on Mondays. Results were more pronounced in patients aged over 75 and those with diabetes and a history of coronary artery disease.

**Conclusions** In this nationwide real world study covering 16 years of hospital admissions for myocardial infarction with symptom onset documented to the nearest minute, Christmas, and Midsummer holidays were associated with higher risk of myocardial infarction, particularly in older and sicker patients, suggesting a role of external triggers in vulnerable individuals.

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Cite this as: *BMJ* 2018;363:k4811
Find the full version with references at http://dx.doi.org/10.1136/bmj.k4811

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- In Western countries, cardiac mortality and hospital admission due to myocardial infarction has been observed to peak at Christmas and New Year
- The risk of myocardial infarction has also been linked to football championships, hurricanes, and stock market crashes
- It is therefore conjectured that factors associated with emotional stress, physical activity, and lifestyle changes may modulate the onset of myocardial infarction by acting as short term triggers

## WHAT THIS STUDY ADDS

- In this large study covering 16 years of clinical myocardial infarction data, a higher risk of myocardial infarction was observed during Christmas/New Year and Midsummer holidays but not during Easter
- The highest risk was during Christmas Eve and in patients over 75, and those with previous diabetes and coronary artery disease
- Sports events were not associated with higher risk of myocardial infarction

## HOLIDAYS IN SWEDEN

**Christmas**
Christmas is celebrated with the immediate family, and Christmas Eve on 24 December is the main day of Christmas festivities. Celebrations continue on Christmas Day and Boxing Day (25 and 26 December, respectively).

**New Year**
New Year's Eve (31 December) is generally celebrated with friends. The festivities involve consuming food and alcoholic drink to excess and awaiting fireworks at midnight to share New Year's resolutions and wish one another a happy new year.

**Easter**
Easter celebration is the first long weekend after winter. Families and friends meet and eat. Eggs are a theme, and children dress as Easter witches.

**Midsummer**
Excepting Christmas, Midsummer is the most important holiday in Sweden. On Midsummer Eve, which precedes the summer solstice, Swedes gather to celebrate by dancing around a maypole, singing, eating, and drinking, often to excess. It is associated with the Christian holiday, the Feast Day of St John the Baptist, on 24 June.

## Introduction

Studies have shown a peak in cardiac mortality in the Western world on Christmas Day and New Year's holiday.[21-24] However, most studies have used surrogate variables, such as ambulance records and death certificates, as indicators of myocardial infarction, and as such may introduce bias through misclassification and uncertainties in time of symptom onset.

We hypothesised that short term risk factors, such as holidays, sports events, and time of year or day, may be associated with a higher risk of myocardial infarction. Furthermore, we hypothesised that the potential risk may differ for electrocardiogram (ECG) subtypes of myocardial infarction: ST elevation myocardial infarction (STEMI) and non-ST elevation MI (NSTEMI). Our objective was therefore to study national holidays, major sports events, and circadian rhythm aspects as triggers of ECG and biomarker positive myocardial infarctions with high quality data on symptom onset documented to the nearest minute, in a large nationwide setting.

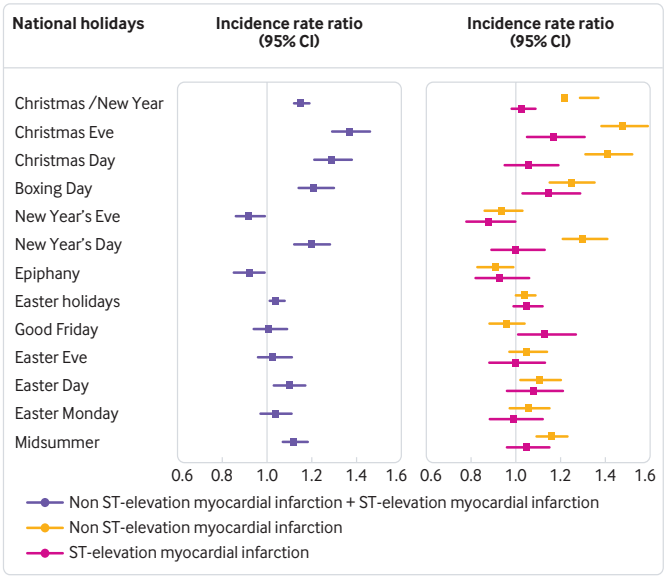



**Fig 1 | Associated risks of national holidays and myocardial infarction. ST elevation myocardial infarction and non-ST elevation myocardial infarction expressed as incidence rate ratios for all major national holidays**

During Christmas and New Year the overall risk of myocardial infarction increased by 15%. The risk on Christmas Eve was higher than on the other days

## Methods

### Study population

We used the prospective nationwide Swedish Web System for Enhancement and Development of Evidence-Based Care in Heart Disease Evaluated According to Recommended Therapies (SWEDEHEART) registry to identify cases of myocardial infarction in Sweden between 1998 and 2013.[26] The date and time of symptom onset are documented to the nearest minute, and we used these as the main variables in this study.

### Study design

We identified all cases of myocardial infarction with symptom onset on Christmas/New Year, Easter, and Midsummer holiday (box). Similarly, we identified all myocardial infarctions that occurred during FIFA World Cup tournaments, UEFA European Championship tournaments, and winter and summer Olympic Games in the study period. The two weeks before and after a holiday were set as the control period. For sports events, we set the control period to the same period one year before and after the tournament. The primary outcome was daily count of myocardial infarction, with STEMI and NSTEMI studied independently as secondary outcome measures.

We assessed pre-specified subgroup analyses for all periods of interest. These subgroups were based on sex, age ≥75 versus age <75, smoking status, diabetes, hypertension, coronary artery disease, and patients taking drugs such as β blockers, calcium inhibitors, aspirin, angiotensin converting enzyme inhibitors/angiotensin receptor blockers, and statins. We conducted a sensitivity analysis of the risk of myocardial infarction on days where the Swedish football team was involved in the FIFA World Cup and UEFA European Championship tournaments. In addition, we conducted sensitivity analyses adjusted for year as a categorical variable to control for time trends in myocardial infarction during the study period. For details of the methods and statistical analysis, see bmj.com.

## Results

During the study period, there were 283 014 admissions for myocardial infarction (table 1, bmj.com). 95 176 patients had STEMI.

A higher risk of myocardial infarction was observed for Christmas Eve, Christmas Day, Boxing Day, and New Year's Day, but not for New Year's Eve and Epiphany (fig 1, fig 2, see bmj.com). During Christmas/New Year the overall risk of myocardial infarction increased by 15% (incidence rate ratio 1.15, 95% confidence interval 1.12 to 1.19, P<0.001). Risk of myocardial infarction on Christmas Eve was higher than on the other days of the holiday (1.37, 1.29 to 1.46, P<0.001), with higher risk of NSTEMI (1.48, 1.38 to 1.59, P<0.001). Easter was not associated with a higher incidence rate ratio of myocardial infarction, while Midsummer was associated with a higher risk (1.12, 1.07 to 1.18, P=0.001) largely driven by a higher risk of NSTEMI (1.16, 1.09 to 1.23, P<0.001).

During the study period, four FIFA World Cup tournaments and four UEA European Championships took place. These sports events were not associated with a higher incidence of myocardial infarction.

A statistically significant circaseptan variation in the incidence of myocardial infarction was evident on Mondays, and after stratification into NSTEMI and STEMI. We observed a statistically significantly higher incidence of myocardial infarction in the analysis of hour of symptom onset, peaking at 8 am, most prominently for NSTEMI (fig 3, fig 4, supplementary table 1, see bmj.com).

## Discussion

We observed the highest risk of myocardial infarction (37% higher than during the control period) on Christmas Eve. Previous meta-analyses have shown that acute experience of anger, anxiety, sadness, and stress increases the risk of myocardial infarction and thus possibly explains the higher risk we observed.[8 13]

We found a 20% higher risk of myocardial infarction on New Year's Day. This could be caused by excess alcohol and food consumption, exposure to low temperatures, or sleep deprivation on New Year's Eve.

Previous studies have shown a higher risk of myocardial infarction in the working population.[29] We found the pattern to be similar in both retired (≥75 years) and younger patients (<75 years).

Previously proposed explanations to the circaseptan peak in myocardial infarction include stressful Mondays and a rise in arterial blood pressure and heart rate.[30] The circadian variation has been attributed to peak cortisol levels, increased blood viscosity, and platelet aggregability in addition to a rise in arterial blood pressure and heart rate in the morning hours.[5]

Our results showed a consistently higher risk of myocardial infarction mainly due to higher rates of NSTEMI and a greater number of patients who were elderly, had diabetes, a history of coronary artery disease, or were already taking other medication. This indicates that the "vulnerable patient," who may have risk factors such as blood vulnerable to thrombosis and myocardium vulnerable to arrhythmias in addition to vulnerable plaques, may be more prone to these precipitators of disease.[32]

Activities and emotions associated with holidays may result in myocardial infarction secondary to ischaemia, due to an increased oxygen demand in older and sicker patients. This is supported by the subgroup analysis on the Christmas and New Year's holiday (supplementary fig 2, see bmj.com) that showed an incremental risk increase of myocardial infarction with each age quartile.[33]

# Is it time to start using the emoji in biomedical literature?

As the pictograph continues to gain in popularity, **Vikas O'Reilly-Shah and colleagues** explore its potential role in scientific communication

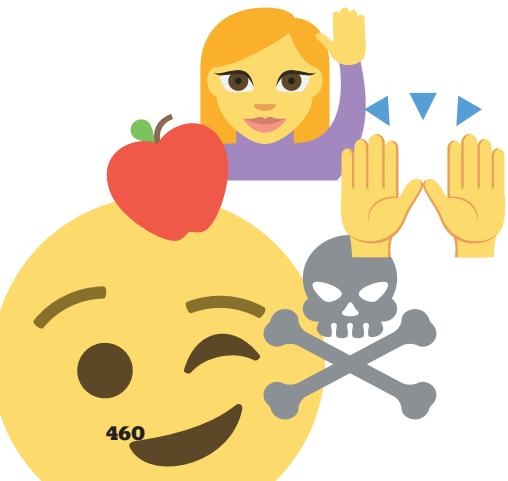
Potential emoji based alternatives to denotation of statistical significance

| P-value | American Psychological Association style denotation | Emoji denotation 1 | Emoji denotation 2 |
|---|---|---|---|
| P>0.05 | ns | 😕 | 👎 |
| P≤0.05 | * | 🙂 | 👍 |
| P≤0.01 | ** | 😀 | 💪 |
| P≤0.001 | *** | 😎 | 💯 |

The explosion of smartphone technology has brought with it a transformation of the English language. Using the original 256 character American Standard Code for Information Interchange (ASCII) set,[1] initial forays into digital communication were laborious at best, requiring complete sentences and actual punctuation to convey meaning. No longer.

In October 2010 the Unicode Consortium added emoji to its evolving standardised universal character set, allowing for vast swaths of the human experience to be communicated by a single character. Their use in the scientific literature has already begun: at least one paper has included emoji in the abstract,[2] and a brief piece on scientific emoji was featured in *Nature*.[3] (The plural of *emoji* is under some debate.[4 5] In our view, "emoji" without the pluralising *s* is much more aesthetically appealing than "emojis.")

Given the potential for economy of language, an augmented range of expression, the need to study our contemporary lexicon, and the entry of a new generation of scientists into writing and publishing, the time is ripe to discuss the value and potential pitfalls associated with using emoji in the biomedical literature.



## Great possibilities! 🎉🎊✴️

Emoji are single character images conveying stylised facial expressions, objects, animals, flags/signs, weather patterns, and activities. Originally developed in the 1990s, they have been adopted worldwide and are a core element of current electronic communications. As one author put it, emoji "scaffold our electronic communications. Yes, they are cute and fun and kind of addictive, but they also improve our capacity to make our intended meaning known."[6] The position of emoji in popular culture is further demonstrated by the selection of the "face with tears of joy" ( 😂 ) emoji as the Oxford Dictionaries Word of the Year in 2015.[7]

Integrating emoji into the scientific literature would be advantageous in several obvious areas, such as modulating the emotional tone of communications. In editorials and letters to editors they may serve great purpose by introducing inflection and subtext in a manner not previously possible. For example:

"In this issue, Dr. Superstar and colleagues report minituarizing themselves and repairing oncogenic DNA mutations by hand 😱🙏"

"It is with great interest that we read the article by Dr. Doe and colleagues 😒"

"We wish to thank Dr. Obtuse for their detailed response to our article. We performed the sensitivity analysis as requested, and the findings were essentially unchanged 🤦‍♀️"

Consider also the possibilities in peer review and editorial communications:

"This article has been retracted by the Editor-in-Chief on grounds of fraudulent reporting 😬"

"We invite the authors to submit a revised version of their manuscript, although we cannot guarantee acceptance of a revision 😒"

"Regrettably, your submission did not receive a high enough priority rating to warrant its publication 🤦‍♀️⛔"

More routinely, the standard denotation of significance with stars could be revised to use emoji (see table). These alternative scales would enliven the dry, statistical reporting that can quash the excitement inherent in knowledge discovery.

## Dangers ☠️💣⚡

We should also consider several important downsides. Firstly, the significant lack of standardisation in the specific artwork deployed for a particular emoji. For example, the figure shows the emoji for Santa Claus and Mrs Claus displayed on a variety of platforms, obtained from the Unicode Consortium website.[8] (A tangential point of criticism for the Unicode Consortium: why are the Claus family emoji categorised under "Person fantasy" 😘 ?)

As should be clear from a cursory inspection, the mood of the characters ranges from jolly to somewhat sombre ("naughty list" Santa, perhaps?). Although variability in the underlying artwork for a given emoji may be easy to control when publishing in print or as a PDF, most publishers now also provide this content in web friendly formats. Readers may experience significant variability in emoji display if viewing on different platforms.

Santa Claus and Mrs Claus

| No | Code | Browser | Apple | Google | Twitter | Emoji One | Facebook | Samsung | Microsoft |
|---|---|---|---|---|---|---|---|---|---|
| 192 | U+1F385 | | | | | | | | |
| 193 | U+1F936 | | | | | | | | |

Figure | Example of the lack of standardisation in emoji artwork that may cause ambiguity in interpretation. Claus family apparent age and jolliness are highly variable in this example

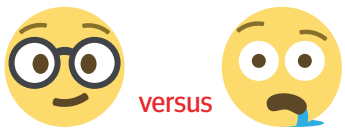
Secondly, two inter-related problems are the durability of an emoji's meaning over time and the potential variability in its meaning in different cultural and linguistic contexts. These authors generally use the venerated "face with tears of joy" ( 😂 ) to impart "laughing so hard I'm crying"—significantly different from its named intent. Similarly, consider the "call me hand": 🤙

This is likely to be interpreted very differently by Hawaiians, Southern Californians, and coastal Brazilians (ie, *shaka brah* 🤙 ).[9] And the "victory hand" ( ✌️ ) may be viewed as either a token of peace or an offensive gesture.[10]

Contextual evolution in the meaning of emoji may convey a completely unintended message when the intended use was completely innocent[11]: 🍆

Clinical medicine is already fertile ground for potential miscommunication, and introducing emoji into the scientific literature may be a bridge too far.[12] If nothing else, it would call for a new type of editorial stewardship—the emoji editor: 👨 💻.

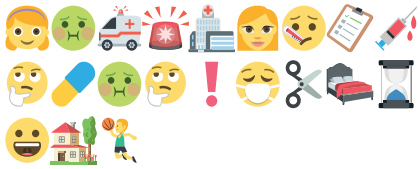
Apart from challenges in display and interpretation, researchers and clinicians are currently left to wonder how adding emoji to their scholarly communications may affect perceptions of their professionalism:[13 14]




Early work has found that consumers may associate emoji use with warmth rather than competence when used during online service encounters.[15] Emoji may ultimately be influential through subtle emotional manipulation, which could negatively colour recipients' opinions of early emoji adopters.[16]

## New structures 📘📚

What might happen to the structure of manuscripts? For example, going from 250 characters in an abstract to 250 emoji is a significant leap. Indeed, an entire abstract could conceivably be captured in emoji. Imagine a case report of a young child admitted by ambulance to an emergency department, in whom a rare disease is uncovered after unrevealing diagnostic studies and failed attempts at conventional treatment. She undergoes a surgical procedure, is discharged home, and makes a full recovery. Such an abstract could be reimagined as follows:



The mechanism of injury and the management of the patient are clearly stated, yet the number of characters is lower than in many complete sentences. The possibilities are numerous—shorter journals, longer journal articles (as measured by the time taken to read), and potentially higher acceptance rates into print journals, since they will have more space to publish.

A final potential concern is the ability of indexing services to handle emoji characters in titles and abstracts. PubMed and MEDLINE use 8 bit Unicode (UTF-8), which should handle most common emoji.[17] However, at least one publication with emoji in the abstract[2] does not seem to have had them rendered for indexing in PubMed, Scopus, or Web of Science. It's not clear whether other indexing services are capable of handling extended character sets. Attendant issues, such as searching by emoji and evaluating their use on social media platforms, are also concerns that will need to be tackled.[18]

## Conclusions 🤔

We live in an exciting time of transformation in communication, in which new mechanisms to convey meaning and to modulate tone are rapidly evolving. The implications of using emoji are 👍, and the power of this language is 🚀. The opportunities to expand


regardless of one's native language, are 🌠. While initially disruptive,

will need to

or else they will

Emoji represent an opportunity for the medical and scientific community to augment how scientific findings are described and discussed. Although logistical concerns remain, we look forward to the day when entire papers are cogently written using concise sets of emoji to convey new results.

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Cite this as: *BMJ* 2018;363:k5033


EDITORIAL

# Medical institutions must divest from fossil fuels

Rapid divestment would break our dependence on this industry

The UK's largest medical royal college, the Royal College of General Practitioners, recently committed to fossil fuel divestment. It joins several other healthcare organisations that are divesting, including the American Medical Association, the Royal Australasian College of Physicians, the Canadian Medical Association, the Australian Medical Students' Association, the UK Faculty of Public Health, and the British Psychological Society.

Evidence that fossil fuels pose serious threats to public and planetary health is overwhelming. The Intergovernmental Panel on Climate Change recently reported that "rapid, far-reaching and unprecedented" action is required to limit global warming to 1.5°C.[1] Exceeding this will have catastrophic effects on human health.

## Notorious record

The fossil fuel industry has a long record of undermining climate science and continues to spread misinformation and obstruct action.[2 3] Fossil fuels are a major contributor to air pollution, killing seven million people every year.[4] WHO estimates that air pollution is responsible for one third of deaths from stroke, lung cancer, and heart disease. Extraction techniques—for example, fracking and enhanced oil recovery—are also associated with water pollution, posing additional risks to health.[5]

Fossil fuel and petrochemical industries are at the root of the plastic crisis. Their business model drives greater volumes of plastic to market.[6] Evidence is emerging that microplastics may contribute to conditions such as cancer, cardiovascular disease, obesity, and reproductive abnormalities.[7]

The amount of carbon in known fossil fuel reserves is about five times more than we can use if global warming is to be limited to 2°C.[8] Despite this, industry continues to explore for more. This sobering reality sparked the global fossil fuel divestment movement, which has led to institutions managing over $7tn of investments committing to divestment.[9]

> If large numbers take a stand, our professional voice will be difficult to ignore

The fossil fuel industry spends large sums donating to and influencing politicians and society leaders, who, in turn, continue to promote the industry.[3 10] It requires a level of public acceptance to be allowed to pollute and damage health. Divestment is important because it reduces the industry's social acceptability and erodes its political power.

The healthcare community played a key role in the tobacco divestment movement, paving the way for stronger anti-tobacco legislation. Divestment can also be used to enable legislation against fossil fuels[10] and accelerate the transition to renewable power. In its 2018 annual report, Shell acknowledged that continued divestment could present a material risk to the company.[11] Its chief executive identified loss of public acceptance as its "biggest challenge."[12]

Fossil fuel assets are increasingly considered to be overvalued. The governor of the Bank of England has stated that a carbon budget consistent with a 2°C target "would render the vast majority of reserves 'stranded'—oil, gas and coal that will be literally unburnable."[13] Even in the absence of new climate policies, modelling suggests that some fossil fuel assets will become worthless given the low carbon technological trajectory.[14] Fossil free investments have performed as well as or better than those that include fossil fuels. Modelling has also found that past divestment would not have impaired portfolio performance over longer periods.[15 16]

Decades of shareholder engagement with fossil fuel companies has failed to shift their core business models. They are still aligned with hazardous levels of warming; the charity ShareAction estimates the core planning scenarios of just BP and Shell are consistent with 3-5°C of warming.[17 18]

Promoting divestment may be one of the most effective social and political tools to help break our dependence on fossil fuels, control the industry's power, and weaken its grip on political institutions.

Our community has a professional mandate to protect society from harm to human health. We have a responsibility to help society move away from fossil fuels and accelerate the transition to renewable energy.

## United front

Health professionals should urge their institutions to divest through direct lobbying or by joining finance committees. We should meet politicians to emphasise the harms to health from a fossil fuel economy and request support for divestment in pension funds. We should support public demonstrations, encourage our organisations to host events, and urge peers to demand rapid transition to clean energy. If large numbers take a stand, our professional voice will be difficult to ignore. We cannot afford to remain silent when the health of so many is at stake.

Adam Law, board president, PSE Healthy Energy, Ithaca, New York
Deidre Duff, fossil fuel free health lead, Medact, London
Patrick Saunders, visiting professor of public health, University of Staffordshire, Stoke on Trent
John Middleton, president, Faculty of Public Health, London
David McCoy, professor of global public health, Queen Mary University, London d.mccoy@qmul.ac.uk

Cite this as: *BMJ* 2018;363:k5163
Find the full version with references at http://dx.doi.org/10.1136/bmj.k5163