Additional file 1: Study protocol

PROTOCOL INFORMATION REQUIRED

The following sections below **must** be included in the CPRD ISAC research protocol. Please refer to the guidance on '***Contents of CPRD ISAC Research Protocols***' (www.cprd.com/isac) for more information on how to complete the sections below. Pages should be numbered. All abbreviations must be defined on first use.

Applicants must complete all sections listed below **Sections which do not apply should be completed as '*Not Applicable*'**

A. Study Title§
§*Please note: This information will be published on CPRD's website as part of its transparency policy*

Healthcare Resource Utilization and Costs among Patients with and without Infection after Intramedullary Nailing for A Tibial Shaft Fracture

B. Lay Summary (Max. 200 words)§
§*Please note: This information will be published on CPRD's website as part of its transparency policy*

Tibial shaft fractures are the most common long bone fracture of the lower limbs. Intramedullary nailing is the most frequent surgical treatment for tibial shaft fractures. In patients with tibial shaft fractures, infection is an important complication as about 15% of these fractures are open injuries. Such infections may lead to devastating consequences such as increase in length of hospital stay, readmissions, prolonged medication treatment and reoperations along with high use of medical resources and costs. However, the healthcare burden among patients developing an infection in tibial shaft fracture is not well documented. Consequently, this study seeks to understand the impact of infection after intramedullary nailing in patients with tibial shaft fractures on healthcare use and cost of care.

C. Technical Summary (Max. 200 words)§
§*Please note: This information will be published on CPRD's website as part of its transparency policy*

The objective of this retrospective longitudinal cohort study is primarily designed to determine short (30-day, 90-day) and mid-term (one-year, two-year) healthcare resource utilization (HRU) and costs among patients with deep and superficial infections versus those without following intramedullary nailing for a tibial shaft fracture. Patients with tibial shaft fracture treated with intramedullary nailing between 2011 and 2016 will be selected. The main exposure variable will include deep infection versus superficial surgical site infection or no infection. Analyses will be both descriptive and comparative using multivariable models. The multivariable models will include generalized linear models (GLMs) based on the outcome variable of interest for HRU and costs and will adjust for patient characteristics.

Applicants must complete all sections listed below
Sections which do not apply should be completed as '*Not Applicable*'

D. Objectives, Specific Aims and Rationale

<u>Broad Research Objectives</u>
To evaluate the impact of developing infection in patients with intramedullary nailing for tibial shaft fractures on healthcare utilization and cost of care.

<u>Specific Aims</u>
1. To determine short (30-day, 90-day) and mid-term (one-year, two-year) Costs and HRU among patients with deep infection and superficial infections versus patients without an infection following tibial shaft fracture treated with nailing.

<u>Rationale</u>

This study seeks to understand the impact of post-surgical infection in patients with intramedullary nailing for tibial shaft fractures on cost of care and healthcare utilization.

E. Study Background

Infections remains a feared complication in orthopaedic and trauma surgery due to its potentially devastating consequences for patients. It has also been associated with an increase in medical resource utilization and treatment costs due to increased length of hospital stay, readmissions, prolonged pharmacological treatment and reoperations. [1-6] Deep infections defined as infections involving deeper tissues such as muscular fascia and bone[7] have been associated with a significant economic burden for healthcare systems. Data from long bone fracture reduction, hip replacement or hemiarthroplasty or screw fixation for proximal humeral fractures and knee arthroplasty, consistently reported 2-3 times higher treatment costs for patients that developed an infection compared to those that did not. [1-6]

Tibial shaft fractures are the most common long bone fracture of the lower limbs.[8] In patients with tibial shaft fractures, infection is an important complication as about 15% of these fractures are open injuries. Infection may lead to prolonged treatment, compromised clinical outcomes and in some cases, even limb amputation. [9-12] In the European setting there is limited data available with respect to the actual cost of treatment. In a Danish study on patients with open tibia fractures treated with a free flap, the presence of an infection increased the mean length of hospital stay from 28 to 63.8 days and the mean treatment costs from €49,301 to €67,958 for infected compared to uninfected fractures.[13] A study from the UK reported the mean length of stay and treatment costs of patients with tibial osteomyelitis. For patients treated with limb salvage procedures alone, length of stay was 15 days (10-27) and corresponding treatment costs were € 16,718 while for patients, whose treatment ended up in amputation length of stay was 13 days (8-17) and treatment costs were €18,441.[14]

Intramedullary nailing is the preferred surgical treatment in patients with tibial shaft fractures. The impact of the development of an infection on short and mid-term post-operative medical resource utilization is not well documented. While literature from clinical trials provides some insight into infection incidence rates, the treatment pathway and treatment success/failure rates, there is a lack of detailed patient-level information particularly in relation to the actual costs of care.

Applicants must complete all sections listed below
Sections which do not apply should be completed as '*Not Applicable*'

F. Study Type

Hypothesis generating
This study will generate the hypothesis for HRU and costs between patients with (deep and superficial) and without infection after intramedullary nailing for tibial shaft fractures

G. Study Design

This is a retrospective cohort study with a longitudinal follow-up for up to two years post intramedullary nailing for tibial shaft fractures.

H. Feasibility counts

Based on the preliminary feasibility study of Hospital Episode Statistics (HES) inpatient data for research grade patients with complete data, we identified a total of 11,329 patients with intramedullary nailing for a tibial shaft fracture between 2011 and 2013 of which 509 patients had an infection following intramedullary nailing for a tibial shaft fracture.

I. Sample size considerations

No prior real-world studies have been conducted to evaluate the health care resource use and costs of interest among patients with and without infection following intramedullary nailing for tibial shaft fracture. Therefore, it is not possible to estimate the sample size

J. Data Linkage Required (if applicable):§
§*Please note that the data linkage/s requested in research protocols will be published by the CPRD as part of its transparency policy*

The Clinical Practice Research Datalink (CPRD) with HES is required to identify the patients and outcomes that are based on diagnosis and procedures recorded in the inpatient setting.

K. Study population

Patients initially selected for tibial shaft fracture (ICD-10, S822) must meet all the following inclusion criteria:

1. Procedure for intramedullary nailing for tibial shaft fracture (appendix) between January 1, 2011 and February 30, 2016
   - Date of first intramedullary nailing for tibial shaft fracture between January 2011 and February 2016 will be the index date
2. Research grade patients with complete medical records for at least 12 months pre- and 30- day post index date. Patients with 90-day, 1- and 2- year follow-up or continuous enrollment will be further analysed.

Patients with the following criteria were excluded:

1. Records for intramedullary nailing for tibial shaft fracture during the 12-month pre-index period
2. Records for treatment with internal fixation (appendix) during the 12-month pre-index period

3. Records for treatment with external fixation (appendix) from 12-month pre-index to 6 weeks pre-index. Records for external fixation during 6 weeks pre-index will be included as external fixation is often performed prior to intramedullary nailing.
4. Records for severe multiple injuries to different parts of the body (polytrauma) (appendix) in the 12-month pre-index period.
5. Records for a fracture in neoplastic disease (appendix) in the 12-month pre-index period.

L. Selection of comparison group(s) or controls

Patients not developing an infection anytime during the study period will be selected as the control group.

M. Exposures, Health Outcomes§ and Covariates
§*Please note: Summary information on health outcomes (as included on the ISAC application form above) will be published on CPRD's website as part of its transparency policy*

Exposure
Patients developing infection during the 12-month post index period.

Outcome(s)

Primary Outcome

One- year inpatient costs

Secondary Outcomes

- Number of hospital readmissions (in 30-days, 90-days, 1 year and 2 years)
- Percent (yes/no) of patients with readmissions (in 30-days, 90-days, 1 year and 2 years)
- Total cost of care at the different time points (in 30-days, 90-days, 1 year and 2 years)
    a. Inpatient admissions
    b. Outpatient costs
    c. Pharmacy

Costs will be expressed in UK pounds and adjusted for inflation to 2015 index. Healthcare costs will be obtained from the Personal Social Services Research Unit (PSSRU) 2015 Cost of Care public document and Healthcare Resource Group (HRG) codes available in HES. Drug costs will be obtained from British National Formulary 71 (March 2016-September 2016).

- Number of procedures for introduction of therapeutic substance (Appendix) (30-days, 90-days, 1 year and 2 years)
- Number of outpatient visits (all-cause) at the different time points (in 30-days, 90-days, 1 year and 2 years)
- Number of diagnostic tests and imaging (all-cause) at the different time points (in 30-days, 90-days, 1 year and 2 years)
- Number of days in ICU (all-cause) at the different time points (in 30-days, 90-days, 1 year and 2 years)
- Time of infection and type of infection (bacterial vs other)

4

Applicants must complete all sections listed below
Sections which do not apply should be completed as '*Not Applicable*'

- Percent (yes/no) of patients with use of antibiotics at the different time points (in 30-days, 90-days, 1 year and 2 years)
- Patients necessitated amputation (Appendix) at the different time points (in 30-days, 90-days, 1 year and 2 years)

Covariates

The covariates information will be captured during 12-month pre-index period and will include the following:

Patient Demographics

- Age
- Gender
- Smoking status

Procedural Characteristics

- Year of the index date

Patient Clinical Characteristics

Comorbidities (Appendix)

- Diabetes
- Dyspnea
- Ventilator requirement
- Chronic obstructive pulmonary disease (COPD)
- Congestive heart failure (CHF)
- Renal failure
- Hypertension

Indices

- Charlson comorbidity index (CCI) - The CCI is an aggregate measure of comorbidity created by using select diagnoses associated with chronic disease (e.g., heart disease, cancer). The CCI includes 17 medical conditions and weights these conditions from +1 to +6.

Medications

- Anti-hypertensive medications
- Opioids

N. Data/ Statistical Analysis

All study variables will be analyzed descriptively. Frequency counts and proportions will be provided for dichotomous and polychotomous variables. Means, medians, and standard deviations will be provided for continuous variables. Time to infection will be depicted graphically using Kaplan-Meier curve.

Unadjusted comparisons of patient demographics, comorbidities and medication use between groups (with and without infection) will be performed with 2-sample t-tests for continuous variables and $\chi 2$ tests for categorical variables and Wilcoxon rank sum tests for cost variables.

A sub-analysis will be conducted in which patients will be stratified by an open fracture and a closed tibial shaft fracture (appendix) to determine the outcomes.

All analyses will be conducted using SAS for Windows. Statistical significance will be set a-priori at $p < 0.05$ (two-sided).

In addition, a generalized Linear Model (GLM) will be utilized to get adjusted results after control for confounding. Details of this methods are mentioned in the section below:

O. Plan for addressing confounding

Multivariable models will be constructed to examine the impact of infection versus no infection and other patient characteristics for healthcare utilization and cost outcomes. A Generalized Linear Model (GLM) will be utilized and the appropriate error distribution and link function will be used based on the outcome variable of interest for utilization and costs.

Following standard procedures, for each model regression diagnostics will be performed to assess goodness of fit and violations of model assumptions. Appropriate modifications will be made as needed either through selection of alternative error distributions or link functions, or through transformations of either the independent or dependent variables. We will also examine the fitted and the observed data to uncover outliers, their effect on the analysis, and possible misspecification of the initial equation.

P. Plans for addressing missing data

Missing data will not be imputed for the analyses. Most variables (drugs, procedures, diagnosis) can have no missing values, as they are assumed not to have occurred unless a record is identified. To be included in the study, patients will need to have complete medical history for at least 12 months pre-index to 12 months post-index date.

Q. Patient or user group involvement (if applicable)

This is purely an observational study using CPRD with HES linkage data. This study does not involve requesting additional information from GPs. Also, the study does not require contacting patients to get any additional information.

R. Plans for disseminating and communicating study results, including the presence or absence of any restrictions on the extent and timing of publication

The study will be disseminated per the ICMJE guidelines. We plan on submitting the results to a peer-reviewed journal and presenting the results at scientific conferences.

S. Limitations of the study design, data sources, and analytic methods

6

Applicants must complete all sections listed below
Sections which do not apply should be completed as '*Not Applicable*'

- Potential bias in patient population: only patients with complete medical history for 12 months post index will be included, thus excluding very severe patients with less than 12 month life expectancy
- Coding errors and misclassifications
- Under-reported or missing diagnoses, based on patients' choice (not to seek care) or access challenges
- Identify pharmacy cost in terms of medication prescribed in the primary care setting only
- Cost evaluated using PSSRU, HRG and BNF codes as the costs are not directly available in the data

T. References

1. de Lissovoy G, Fraeman K, Hutchins V, et al. Surgical site infection: incidence and impact on hospital utilization and treatment costs. American journal of infection control 2009;**37**(5):387-97.

2. Jenks PJ, Laurent M, McQuarry S, et al. Clinical and economic burden of surgical site infection (SSI) and predicted financial consequences of elimination of SSI from an English hospital. The Journal of hospital infection 2014;**86**(1):24-33.

3. Pollard TC, Newman JE, Barlow NJ, et al. Deep wound infection after proximal femoral fracture: consequences and costs. The Journal of hospital infection 2006;**63**(2):133-9.

4. Schmidt A, Benard S, Cyr S. Hospital Cost of Staphylococcal Infection after Cardiothoracic or Orthopedic Operations in France: A Retrospective Database Analysis. Surgical infections 2015;**16**(4):428-35.

5. Thakore RV, Greenberg SE, Shi H, et al. Surgical site infection in orthopedic trauma: A case-control study evaluating risk factors and cost. Journal of clinical orthopaedics and trauma 2015;**6**(4):220-6.

6. Wijeratna MD, McRoberts J, Porteous MJ. Cost of infection after surgery for intracapsular fracture of the femoral neck. Annals of the Royal College of Surgeons of England 2015;**97**(4):283-6.

7. Metsemakers WJ, Handojo K, Reynders P, et al. Individual risk factors for deep infection and compromised fracture healing after intramedullary nailing of tibial shaft fractures: a single centre experience of 480 patients. Injury 2015;**46**(4):740-5.

8. Minhas SV, Ho BS, Switaj PJ, et al. A comparison of 30-day complications following plate fixation versus intramedullary nailing of closed extra-articular tibia fractures. Injury 2015;**46**(4):734-9.

9. Buckley RE, Colton C. Infection. Secondary Infection 2012. https://www2.aofoundation.org/wps/portal/surgery?showPage=redfix&bone=Tibia&segment=Shaft&classification=42-Special%20considerations&treatment=&method=Special%20considerations&implantstype=Complications&approach=&redfix_url=1341319024234.

10. Hannigan GD, Pulos N, Grice EA, et al. Current Concepts and Ongoing Research in the Prevention and Treatment of Open Fracture Infections. Advances in wound care 2015;**4**(1):59-74.

11. Kanakaris NK, Tosounidis TH, Giannoudis PV. Surgical management of infected non-unions: An update. Injury 2015;**46 Suppl 5**:S25-32.

12. Mouzopoulos G, Kanakaris NK, Kontakis G, et al. Management of bone infections in adults: the surgeon's and microbiologist's perspectives. Injury 2011;**42 Suppl 5**:S18-23.

13. The cost of infection in severe open tibial fractures treated with a free flap. 34th Annual Meeting of the European Bone & Joint Infection Society; 2015; Lisbon, Portugal.

14. Kendall J, Jones, S., Mcnally, M. Income and costs of treating tibial osteomyelitis in the uk – a comparison of limb salvage versus amputation. 34th Annual Meeting of the European Bone & Joint Infection Society. Lisbon, Portugal, 2015.

List of Appendices *(Submit all appendices as separate documents to this application)*

Applicants must complete all sections listed below
Sections which do not apply should be completed as '*Not Applicable*'

Appendix 1: OPCS-4 codes to identify intramedullary nailing for long bones

Appendix 2 OPCS-4 codes to identify internal fixation

Appendix 3 OPCS-4 codes to identify external fixation

Appendix 4: ICD-10 codes to identify severe multiple injuries

Appendix 5: Read codes to identify fracture due to neoplastic disease

Appendix 6: ICD-10, OPCS and Read codes to identify infection

Appendix 7: OPCS-4 codes to identify procedures for introduction of therapeutic substance

Appendix 8: OPCS-4 codes to identify procedures amputation of tibia bone

Appendix 9: Read codes to identify diabetes mellitus with and without complications

Appendix 10: Read codes to identify dyspnoea

Appendix 11: Read codes to identify ventilator requirement

Appendix 12: Read codes to identify COPD

Appendix 13: Read codes to identify heart failure

Appendix 14: Read codes to identify renal failure

Appendix 15: Read codes to identify hypertension

Appendix 16: Read, ICD-10 and OPCS codes to identify open and closed tibial shaft fracture

Appendix 17: Read codes to identify Charlson comorbidity index

Appendix 18: OPCS codes to identify reoperations

1. OPCS-4 codes to identify intramedullary nailing for long bones

OPCS-4	Description
W192	Primary open reduction of fracture of long bone and fixation using rigid nail NEC
W242	Closed reduction of fracture of long bone and rigid internal fixation NEC

2. OPCS-4 codes to identify internal fixation

OPCS-4	Description
O172	Remanipulation of fracture of long bone and rigid internal fixation NEC
O173	Remanipulation of fracture of long bone and flexible internal fixation HFQ
O175	Remanipulation of fragment of bone and fixation using screw
O178	Other specified secondary closed reduction of fracture of bone and internal fixation
O179	Unspecified secondary closed reduction of fracture of bone and internal fixation
W195	Primary open reduction of fragment of bone and fixation using screw
W196	Primary open reduction of fragment of bone and fixation using wire system
W198	Other specified primary open reduction of fracture of bone and intramedullary fixation
W199	Unspecified primary open reduction of fracture of bone and intramedullary fixation

8

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

OPCS-4	Description
W201	Primary open reduction of fracture of long bone and extramedullary fixation using plate NEC
W202	Primary open reduction of fracture of long bone and extramedullary fixation using cerclage
W203	Primary open reduction of fracture of long bone and extramedullary fixation using suture
W204	Primary open reduction of fracture of long bone and complex extramedullary fixation NEC
W208	Other specified primary open reduction of fracture of bone and extramedullary fixation
W209	Unspecified primary open reduction of fracture of bone and extramedullary fixation
W231	Secondary open reduction of fracture of bone and intramedullary fixation HFQ
W232	Secondary open reduction of fracture of bone and extramedullary fixation HFQ
W236	Secondary open reduction of fracture of bone and internal fixation HFQ
W248	Other specified closed reduction of fracture of bone and internal fixation
W249	Unspecified closed reduction of fracture of bone and internal fixation
W281	Application of internal fixation to bone NEC
W282	Adjustment to internal fixation of bone NEC
W283	Removal of internal fixation from bone NEC
W288	Other specified other internal fixation of bone
W289	Unspecified other internal fixation of bone

3. OPCS-4 codes to identify external fixation

OPCS-4	Description
W222	Primary open reduction of fracture of bone and external fixation HFQ
W235	Secondary open reduction of fracture of bone and external fixation HFQ
W252	Closed reduction of fracture of bone and fixation using functional bracing system
W253	Remanipulation of fracture of bone and external fixation HFQ
W258	Other specified closed reduction of fracture of bone and external fixation
W259	Unspecified closed reduction of fracture of bone and external fixation
W301	Application of external fixation to bone NEC
W302	Adjustment to external fixation of bone NEC
W303	Removal of external fixation from bone NEC
W304	Application of external ring fixation to bone NEC
W308	Other specified other external fixation of bone
W309	Unspecified other external fixation of bone

4. ICD-10 codes to identify severe multiple injuries

ICD-10 codes	Description
S097	Multiple injuries of head
S197	Multiple injuries of neck
S277	Multiple injuries of intrathoracic organs
S297	Multiple injuries of thorax
S397	Other multiple injuries of abdomen, lower back and pelvis
S497	Multiple injuries of shoulder and upper arm
S597	Multiple injuries of forearm
S647	Injury of multiple nerves at wrist and hand level
S697	Multiple injuries of wrist and hand
S797	Multiple injuries of hip and thigh
S897	Multiple injuries of lower leg
S997	Multiple injuries of ankle and foot
T042	Crushing injuries involving multiple region of upper limb(s)
T043	Crushing injuries involving multiple region of lower limb(s)
T062	Injuries of nerves involving multiple body regions
T063	Injuries of blood vessels involving multiple body regions
T068	Other specified injuries involving multiple body regions
T07X	Unspecified multiple injuries

5. Read codes to identify fracture due to neoplastic disease

Medcode	Read_code	Description
54834	N331700	Fracture of bone in neoplastic disease

6. ICD-10, OPCS and Read codes to identify infection

ICD-10 codes	Description	Deep/Superficial
A498	Other bacterial infections of unspecified site	Deep
A499	Bacterial infection, unspecified	Deep
A544	Gonococcal infection of musculoskeletal system	Deep
L088	Other spec local infections of skin and subcutaneous tissue	Superficial
L089	Local infection of skin and subcutaneous tissue, unspecified	Superficial
T814	Infection following a procedure, not elsewhere classified	Deep

Medcode	Read_code	Description	Deep/Superficial
3128	M07z.00	Local infection skin/subcut tissue NOS	Superficial
6956	SK03.00	Post-traumatic wound infection NEC	Deep
7155	N302.11	Bone infection	Deep
51854	SP25600	Postoperative wound infection-deep	Deep
20342	N30..00	Osteomyelitis, periostitis, other infections affecting bone	Deep
21073	M07y.00	Local infection of skin or subcutaneous tissue OS	Superficial
25363	SP06800	Infection and inflamm reac due inter ortho device	Deep
40293	SP06.00	Infection and inflammation due to internal prosthetic device	Deep
30381	SP05612	[X]Prosthetic infection	Deep
33381	A3Byz00	Other specified bacterial infection NOS	Superficial
43058	N30z.00	Bone infection NOS	Deep
39830	N300.12	Acute bone infection	Deep
40293	SP06.00	Infection and inflammation due to internal prosthetic device	Deep
52122	Myu0.00	[X]Infections of the skin and subcutaneous tissue	Superficial
69280	N30z600	Bone infection NOS, of the lower leg	Deep
69855	N30y600	Other infections involving bone, of the lower leg	Deep
4207	M03z000	Cellulitis NOS	Superficial

OPCS-4	Description	Deep/Superficial
S571	Debridement of skin NEC	Superficial
W332	Debridement of open fracture of bone	Deep
T963	Debridement of soft tissue NEC	Deep
W336	Debridement of bone NEC	Deep

7. OPCS-4 codes to identify procedures for debridement or introduction of therapeutic substance

OPCS-4	Description
S571	Debridement of skin NEC
W332	Debridement of open fracture of bone
T963	Debridement of soft tissue NEC

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

W336	Debridement of bone NEC
W283	Removal of internal fixation from bone NEC
X292	Continuous intravenous infusion of therapeutic substance NEC
S523	Insertion of therapeutic substance into subcutaneous tissue NEC
W351	Introduction of therapeutic substance into bone

8. OPCS-4 codes to identify procedures amputation of tibia bone

OPCS-4	Description
X094	Amputation of leg through knee
X095	Amputation of leg below knee
X098	Other specified amputation of leg
X099	Unspecified amputation of leg

9. Read codes to identify diabetes mellitus with and without complications

Medcodes	Read code	Description
231370	66AJ.11	Unstable diabetes
297735	C108600	Insulin dependent diabetes mellitus with gangrene
288454	C101100	Diabetes mellitus, adult onset, with ketoacidosis
344495	C10M.00	Lipoatrophic diabetes mellitus
224500	C103000	Diabetes mellitus, juvenile type, with ketoacidotic coma
233608	C109500	Non-insulin dependent diabetes mellitus with gangrene
251808	C109900	Non-insulin-dependent diabetes mellitus without complication
331810	C109412	Type 2 diabetes mellitus with ulcer
344028	C10FG00	Type 2 diabetes mellitus with arthropathy
279344	C109.11	NIDDM - Non-insulin dependent diabetes mellitus
343531	C109G11	Type II diabetes mellitus with arthropathy
279348	C10z.00	Diabetes mellitus with unspecified complication
342740	C10EM11	Type I diabetes mellitus with ketoacidosis
279343	C107200	Diabetes mellitus, adult with gangrene
210870	250 GA	Gangrene diabetic
339961	C10FJ00	Insulin treated Type 2 diabetes mellitus
308067	C108911	Type I diabetes mellitus maturity onset
297727	C102z00	Diabetes mellitus NOS with hyperosmolar coma
283820	250 HC	Hypoglycaemic Coma Diabetic
303253	250 AK	Maturity Onset Diabetes Mellitus Insulin
243302	G73y000	Diabetic Peripheral Angiopathy

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance
placed on this supplemental material which has been supplied by the author(s)

BMJ Open

Medcodes	Read code	Description
306131	250 E	Hypoglycaemia In Diabetes Mellitus
249566	66AJ.00	Diabetic - Poor Control
331925	C109J12	Insulin treated Type II diabetes mellitus
309010	C109F12	Type 2 diabetes mellitus with peripheral angiopathy
242649	C109300	Non-insulin-dependent diabetes mellitus with multiple comps
242646	C108400	Unstable insulin dependent diabetes mellitus
340367	C10F900	Type 2 diabetes mellitus without complication
206461	C10y.00	Diabetes mellitus with other specified manifestation
344412	C10F.11	Type II diabetes mellitus
341116	C10FL00	Type 2 diabetes mellitus with persistent proteinuria
306134	250 NT	UNSTABLE DIABETIC
309704	C109G00	Non-insulin dependent diabetes mellitus with arthropathy
343565	C109G12	Type 2 diabetes mellitus with arthropathy
249564	66A5.00	Diabetic on insulin
308094	C109511	Type II diabetes mellitus with gangrene
243795	L180600	Pre-existing diabetes mellitus, non-insulin-dependent
256384	250 PR	Pruritus Diabetic
341003	C10FN00	Type 2 diabetes mellitus with ketoacidosis
341356	C10E400	Unstable type 1 diabetes mellitus
270277	C10zy00	Other specified diabetes mellitus with unspecified comps
341680	C10D.00	Diabetes mellitus autosomal dominant type 2
288459	C107z00	Diabetes mellitus NOS with peripheral circulatory disorder
341002	C10EN00	Type 1 diabetes mellitus with ketoacidotic coma
303258	250 CT	Diabetic Cataract
215438	C101000	Diabetes mellitus, juvenile type, with ketoacidosis
206451	C100011	Insulin dependent diabetes mellitus
229069	250 JA	Diabetic Acidosis
309863	C108411	Unstable type I diabetes mellitus
303250	250 A	Sugar Diabetes
206452	C103.00	Diabetes mellitus with ketoacidotic coma
261004	C107.11	Diabetes mellitus with gangrene
303263	250 JL	Ketosis Diabetic
303256	250 AN	Diabetes
341598	C10E500	Type 1 diabetes mellitus with ulcer

Medcodes	Read code	Description
242650	C109400	Non-insulin dependent diabetes mellitus with ulcer
297739	C10yy00	Other specified diabetes mellitus with other spec comps
292948	250 AB	Abscess Diabetic
307957	C109711	Type II diabetes mellitus - poor control
261009	C10A000	Malnutrition-related diabetes mellitus with coma
339633	C10F.00	Type 2 diabetes mellitus
309658	C109J11	Insulin treated non-insulin dependent diabetes mellitus
223592	8A13.00	Diabetic stabilisation
233607	C108.00	Insulin dependent diabetes mellitus
347683	C10EG00	Type 1 diabetes mellitus with peripheral angiopathy
340865	C108E12	Type 1 diabetes mellitus with hypoglycaemic coma
302787	C108.13	Type I diabetes mellitus
270271	C107100	Diabetes mellitus, adult, peripheral circulatory disorder
233609	C10A100	Malnutrition-related diabetes mellitus with ketoacidosis
261001	C102000	Diabetes mellitus, juvenile type, with hyperosmolar coma
237987	250 AT	Diabetic Amyotrophy
308119	C109411	Type II diabetes mellitus with ulcer
341509	C10F500	Type 2 diabetes mellitus with gangrene
303262	250 JK	Ketoacidosis Diabetic
297726	C102100	Diabetes mellitus, adult onset, with hyperosmolar coma
308004	C108E11	Type I diabetes mellitus with hypoglycaemic coma
339527	C109K00	Hyperosmolar non-ketotic state in type 2 diabetes mellitus
247153	250 G	Ulcer Diabetic
258769	66AJz00	Diabetic - poor control NOS
347258	C10FJ11	Insulin treated Type II diabetes mellitus
297734	C108500	Insulin dependent diabetes mellitus with ulcer
309300	C109J00	Insulin treated Type 2 diabetes mellitus
341126	C10E800	Type 1 diabetes mellitus - poor control
309125	C108812	Type 1 diabetes mellitus - poor control
206454	C107400	NIDDM with peripheral circulatory disorder
343055	C10G.00	Secondary pancreatic diabetes mellitus
340580	C10EM00	Type 1 diabetes mellitus with ketoacidosis
331540	66AV.00	Diabetic on insulin and oral treatment
298869	L180500	Pre-existing diabetes mellitus, insulin-dependent

Medcodes	Read code	Description
342313	C10FP00	Type 2 diabetes mellitus with ketoacidotic coma
297725	C100.00	Diabetes mellitus with no mention of complication
344338	C10E600	Type 1 diabetes mellitus with gangrene
333576	C109D12	Type 2 diabetes mellitus with hypoglycaemic coma
341127	C10FF00	Type 2 diabetes mellitus with peripheral angiopathy
261005	C108.12	Type 1 diabetes mellitus
206457	C109.00	Non-insulin-dependent diabetes mellitus
331823	C109D00	Non-insulin dependent diabetes mellitus with hypoglyca coma
242656	C10zz00	Diabetes mellitus NOS with unspecified complication
340814	C10EE00	Type 1 diabetes mellitus with hypoglycaemic coma
295382	66AS.00	Diabetic annual review
233606	C107000	Diabetes mellitus, juvenile ??? circulatory disorder
347648	C10E412	Unstable insulin dependent diabetes mellitus
341139	C10E900	Type 1 diabetes mellitus maturity onset
242642	C101y00	Other specified diabetes mellitus with ketoacidosis
344989	C10FL11	Type II diabetes mellitus with persistent proteinuria
247152	250 DR	Diabetic Diarrhoea
283822	250 NH	Hyperosmolar Diabetic State
303259	250 DC	Dietary Control Diabetes
310005	C109712	Type 2 diabetes mellitus - poor control
270372	Cyu2.00	[X]Diabetes mellitus
270268	C10..00	Diabetes mellitus
346131	C10EA00	Type 1 diabetes mellitus without complication
279341	C100z00	Diabetes mellitus NOS with no mention of complication
297729	C103z00	Diabetes mellitus NOS with ketoacidotic coma
331809	C108G00	Insulin dependent diab mell with peripheral angiopathy
308089	C108E00	Insulin dependent diabetes mellitus with hypoglycaemic coma
215437	C101.00	Diabetes mellitus with ketoacidosis
347882	C10E812	Insulin dependent diabetes mellitus - poor control
341302	C10F700	Type 2 diabetes mellitus - poor control
222266	66AK.00	Diabetic - cooperative patient
270276	C10B000	Steroid induced diabetes mellitus without complication
233603	C100111	Maturity onset diabetes
339632	C10E.00	Type 1 diabetes mellitus

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

Medcodes	Read code	Description
223655	8H2J.00	Admit diabetic emergency
283823	2500AH	Latent Diabetes
285267	1434	H/O: diabetes mellitus
308820	C108811	Type I diabetes mellitus - poor control
344076	C10E.12	Insulin dependent diabetes mellitus
270269	C100100	Diabetes mellitus, adult onset, no mention of complication
341357	C10F400	Type 2 diabetes mellitus with ulcer
242655	C10z100	Diabetes mellitus, adult onset, unspecified complication
280482	L180X00	Pre-existing diabetes mellitus, unspecified
341557	8BL2.00	Patient on maximal tolerated therapy for diabetes
242653	C10yz00	Diabetes mellitus NOS with other specified manifestation
288455	C102.00	Diabetes mellitus with hyperosmolar coma
270275	C10A.00	Malnutrition-related diabetes mellitus
270273	C108.11	IDDM-Insulin dependent diabetes mellitus
215439	C101z00	Diabetes mellitus NOS with ketoacidosis
342317	C10FD00	Type 2 diabetes mellitus with hypoglycaemic coma
261007	C108800	Insulin dependent diabetes mellitus - poor control
303261	250 HP	Precoma Diabetic
341856	C10EK00	Type 1 diabetes mellitus with persistent proteinuria
303252	250 AD	Diabetes Mellitus Insulin Dependant
347025	C10H.00	Diabetes mellitus induced by non-steroid drugs
270270	C107.00	Diabetes mellitus with peripheral circulatory disorder
332066	C10D.11	Maturity onset diabetes in youth type 2
224506	C107300	IDDM with peripheral circulatory disorder
340332	C109F11	Type II diabetes mellitus with peripheral angiopathy
309143	C109D11	Type II diabetes mellitus with hypoglycaemic coma
341409	C10EL00	Type 1 diabetes mellitus with persistent microalbuminuria
242641	C100112	Non-insulin dependent diabetes mellitus
340474	C10FM00	Type 2 diabetes mellitus with persistent microalbuminuria
261095	Cyu2000	[X]Other specified diabetes mellitus
288460	C109.12	Type 2 diabetes mellitus
224501	C103y00	Other specified diabetes mellitus with coma
302788	C109.13	Type II diabetes mellitus
332948	C108511	Type I diabetes mellitus with ulcer

Medcodes	Read code	Description
347834	C10EN11	Type I diabetes mellitus with ketoacidotic coma
297738	C109700	Non-insulin dependent diabetes mellitus - poor control
283819	250 H	Coma Diabetic
215444	C10y100	Diabetes mellitus, adult, other specified manifestation
346130	C10E.11	Type I diabetes mellitus
344745	C10N.00	Secondary diabetes mellitus
347629	C10F711	Type II diabetes mellitus - poor control
277055	66AI.00	Diabetic - good control
251805	C100000	Diabetes mellitus, juvenile type, no mention of complication
206900	F464000	Diabetic cataract
309738	C109212	Type 2 diabetes mellitus with neurological complications
224502	C104000	Diabetes mellitus, juvenile type, with renal manifestation
345097	C109111	Type II diabetes mellitus with ophthalmic complications
341813	2BBP.00	O/E - right eye background diabetic retinopathy
346841	C108C11	Type I diabetes mellitus with polyneuropathy
308934	C108H00	Insulin dependent diabetes mellitus with arthropathy
215442	C109C00	Non-insulin dependent diabetes mellitus with nephropathy
261008	C108B00	Insulin dependent diabetes mellitus with mononeuropathy
297732	C106100	Diabetes mellitus, adult onset, neurological manifestation
206455	C108000	Insulin-dependent diabetes mellitus with renal complications
309524	C109H00	Non-insulin dependent d m with neuropathic arthropathy
251806	C108200	Insulin-dependent diabetes mellitus with neurological comps
343081	C10F100	Type 2 diabetes mellitus with ophthalmic complications
341814	2BBQ.00	O/E - left eye background diabetic retinopathy
309275	C109011	Type II diabetes mellitus with renal complications
252191	F420200	Preproliferative diabetic retinopathy
288456	C105000	Diabetes mellitus, juvenile type, ophthalmic manifestation
347472	C10FR00	Type 2 diabetes mellitus with gastroparesis
288461	C109100	Non-insulin-dependent diabetes mellitus with ophthalm comps
306132	250 F	Neuropathy Diabetic
341286	C10FE00	Type 2 diabetes mellitus with diabetic cataract
308948	C108712	Type 1 diabetes mellitus with retinopathy
242643	C106.13	Diabetes mellitus with polyneuropathy
279760	F420.00	Diabetic retinopathy

Medcodes	Read code	Description
308463	C109612	Type 2 diabetes mellitus with retinopathy
270274	C109B00	Non-insulin dependent diabetes mellitus with polyneuropathy
309943	F420600	Non proliferative diabetic retinopathy
288457	C105y00	Other specified diabetes mellitus with ophthalmic complicatn
309614	C109E11	Type II diabetes mellitus with diabetic cataract
341801	C10FB00	Type 2 diabetes mellitus with polyneuropathy
340973	C10FA00	Type 2 diabetes mellitus with mononeuropathy
347417	C10F611	Type II diabetes mellitus with retinopathy
343003	C10E200	Type 1 diabetes mellitus with neurological complications
342681	C108B11	Type I diabetes mellitus with mononeuropathy
206459	C109600	Non-insulin-dependent diabetes mellitus with retinopathy
298103	F381300	Myasthenic syndrome due to diabetic amyotrophy
224505	C106z00	Diabetes mellitus NOS with neurological manifestation
224503	C104y00	Other specified diabetes mellitus with renal complications
342469	2BBV.00	O/E - left eye proliferative diabetic retinopathy
332953	C108711	Type I diabetes mellitus with retinopathy
279761	F420400	Diabetic maculopathy
201928	250 LG	Diabetic Glomerulosclerosis
309628	C109C12	Type 2 diabetes mellitus with nephropathy
224504	C106.11	Diabetic amyotrophy
207385	K01x111	Kimmelstiel - Wilson disease
206456	C108D00	Insulin dependent diabetes mellitus with nephropathy
341836	C108212	Type 1 diabetes mellitus with neurological complications
242645	C108100	Insulin-dependent diabetes mellitus with ophthalmic comps
288858	F3y0.00	Diabetic mononeuropathy
252174	F372.12	Diabetic neuropathy
234015	F420300	Advanced diabetic maculopathy
347410	C10F011	Type II diabetes mellitus with renal complications
344952	2BBI.00	O/E - left eye stable treated prolif diabetic retinopathy
339960	C10FC00	Type 2 diabetes mellitus with nephropathy
343345	C10EF00	Type 1 diabetes mellitus with diabetic cataract
308504	C109E12	Type 2 diabetes mellitus with diabetic cataract
309757	C108D11	Type I diabetes mellitus with nephropathy
308851	C109B11	Type II diabetes mellitus with polyneuropathy

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

Medcodes	Read code	Description
341264	C10F200	Type 2 diabetes mellitus with neurological complications
346403	C10EB00	Type 1 diabetes mellitus with mononeuropathy
309007	C109H12	Type 2 diabetes mellitus with neuropathic arthropathy
333002	F420800	High risk non proliferative diabetic retinopathy
242647	C108700	Insulin dependent diabetes mellitus with retinopathy
341800	C10EC00	Type 1 diabetes mellitus with polyneuropathy
219965	250 M	Charcot's Diabetic Arthropathy
261411	F374z00	Polyneuropathy in disease NOS
309758	C109112	Type 2 diabetes mellitus with ophthalmic complications
306133	250 N	Diabetic Nephropathy
309796	2BBL.00	O/E - diabetic maculopathy present both eyes
331538	C109012	Type 2 diabetes mellitus with renal complications
242648	C109000	Non-insulin-dependent diabetes mellitus with renal comps
206458	C109200	Non-insulin-dependent diabetes mellitus with neuro comps
341701	F420700	High risk proliferative diabetic retinopathy
215440	C106.12	Diabetes mellitus with neuropathy
342045	2BBS.00	O/E - left eye preproliferative diabetic retinopathy
340163	C109E00	Non-insulin depend diabetes mellitus with diabetic cataract
340357	C10F600	Type 2 diabetes mellitus with retinopathy
297737	C108C00	Insulin dependent diabetes mellitus with polyneuropathy
336008	C108211	Type I diabetes mellitus with neurological complications
340987	C10E000	Type 1 diabetes mellitus with renal complications
310061	C109H11	Type II diabetes mellitus with neuropathic arthropathy
297731	C106.00	Diabetes mellitus with neurological manifestation
308830	C109611	Type II diabetes mellitus with retinopathy
233989	F372.11	Diabetic polyneuropathy
344951	2BBk.00	O/E - right eye stable treated prolif diabetic retinopathy
243072	F420z00	Diabetic retinopathy NOS
288458	C105z00	Diabetes mellitus NOS with ophthalmic manifestation
233604	C105100	Diabetes mellitus, adult onset, ophthalmic manifestation
340333	C10ED00	Type 1 diabetes mellitus with nephropathy
308871	C108F11	Type I diabetes mellitus with diabetic cataract
331568	C108011	Type I diabetes mellitus with renal complications
346291	C10FC11	Type II diabetes mellitus with nephropathy

Medcodes	Read code	Description
340162	C108012	Type 1 diabetes mellitus with renal complications
340507	C109A11	Type II diabetes mellitus with mononeuropathy
252180	F381311	Diabetic amyotrophy
308872	C109C11	Type II diabetes mellitus with nephropathy
347405	C10EQ00	Type 1 diabetes mellitus with gastroparesis
279345	C109A00	Non-insulin dependent diabetes mellitus with mononeuropathy
308715	C108F00	Insulin dependent diabetes mellitus with diabetic cataract
206453	C104.11	Diabetic nephropathy
342033	2BBR.00	O/E - right eye preproliferative diabetic retinopathy
333621	C108J12	Type 1 diabetes mellitus with neuropathic arthropathy
347771	C10FB11	Type II diabetes mellitus with polyneuropathy
297733	C106y00	Other specified diabetes mellitus with neurological comps
256383	250 LK	Kimmelstiel- Wilson Disease/Syndrome
340257	C10FH00	Type 2 diabetes mellitus with neuropathic arthropathy
341459	C10F000	Type 2 diabetes mellitus with renal complications
297730	C105.00	Diabetes mellitus with ophthalmic manifestation
261428	F420100	Proliferative diabetic retinopathy
333249	C109211	Type II diabetes mellitus with neurological complications
261003	C104z00	Diabetes mellitis with nephropathy NOS
341221	C10E100	Type 1 diabetes mellitus with ophthalmic complications

10. Read codes to identify dyspnoea

Medcode	Read_code	Description
3092	R060A00	[D]Dyspnoea
6434	1736.00	Paroxysmal nocturnal dyspnoea
7000	2322.00	O/E - dyspnoea
18116	173D.00	Nocturnal dyspnoea
53771	173C.11	Dyspnoea on exertion

11. Read codes to identify ventilator requirement

Medcode	Read_code	Description
87337	7M36300	Ventilatory support

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

12. Read codes to identify COPD

Medcode	Read code	Description
1001	H3...00	Chronic obstructive pulmonary disease
9520	66YB.00	Chronic obstructive pulmonary disease monitoring
9876	H38..00	Severe chronic obstructive pulmonary disease
10802	H37..00	Moderate chronic obstructive pulmonary disease
10863	H36..00	Mild chronic obstructive pulmonary disease
11287	66YM.00	Chronic obstructive pulmonary disease annual review
18621	66YL.00	Chronic obstructive pulmonary disease follow-up
37247	H3z..11	Chronic obstructive pulmonary disease NOS
45770	66Yg.00	Chronic obstructive pulmonary disease disturbs sleep
45771	66Yh.00	Chronic obstructive pulmonary disease does not disturb sleep
65733	Hyu3100	[X]Other specified chronic obstructive pulmonary disease
67040	H3y..11	Other specified chronic obstructive pulmonary disease
93568	H39..00	Very severe chronic obstructive pulmonary disease
102685	66YB000	Chronic obstructive pulmonary disease 3 monthly review
103007	66YB100	Chronic obstructive pulmonary disease 6 monthly review
103494	14B3.12	History of chronic obstructive pulmonary disease
104985	9NgP.00	On chronic obstructive pulmonary disease supprtv cre pathway
105457	8CMW500	Chronic obstructive pulmonary disease care pathway

13. Read codes to identify heart failure

Medcode	Read_code	Description
398	G580.00	Congestive heart failure
2062	G58..00	Heart failure
4024	G58z.00	Heart failure NOS
9913	1O1..00	Heart failure confirmed
10079	G580.12	Right heart failure
15058	14A6.00	H/O: heart failure
17851	8HBE.00	Heart failure follow-up
21837	G232.00	Hypertensive heart&renal dis wth (congestive) heart failure
23707	G580000	Acute congestive heart failure
27964	G582.00	Acute heart failure
28684	G233.00	Hypertensive heart and renal disease with renal failure
30779	662W.00	Heart failure annual review
32671	G580100	Chronic congestive heart failure

Medcode	Read_code	Description
32898	8H2S.00	Admit heart failure emergency
32911	9Or..00	Heart failure monitoring administration
32945	8CL3.00	Heart failure care plan discussed with patient
46912	14AM.00	H/O: Heart failure in last year
60099	67D4.00	Heart failure information given to patient
66306	SP11111	Heart failure as a complication of care
69062	9N6T.00	Referred by heart failure nurse specialist
71235	8Hk0.00	Referred to heart failure education group
83502	662p.00	Heart failure 6 month review
94870	G580400	Congestive heart failure due to valvular disease
96799	G5y4z00	Post cardiac operation heart failure NOS
101137	G583.11	HFNEF - heart failure with normal ejection fraction
101138	G583.00	Heart failure with normal ejection fraction
103732	8CMK.00	Has heart failure management plan
105002	679W100	Education about deteriorating heart failure
105542	8CeC.00	Preferred place of care for next exacerbation heart failure
106198	661M500	Heart failure self-management plan agreed

14. Read codes to identify renal failure

Medcode	Read_code	Description
350	K06..00	Renal failure unspecified
512	K05..00	Chronic renal failure
2266	K04..00	Acute renal failure
6712	K050.00	End stage renal failure
11554	SP15400	Renal failure as a complication of care
11773	7L1A.11	Dialysis for renal failure
15945	SK05.00	Renal failure following crush syndrome
16929	D215.00	Anaemia secondary to renal failure
24292	SP15412	Post operative renal failure
24676	SK08.00	Acute renal failure due to rhabdomyolysis
25394	D215000	Anaemia secondary to chronic renal failure
25582	K04z.00	Acute renal failure NOS
28684	G233.00	Hypertensive heart and renal disease with renal failure
31549	7L1A.00	Compensation for renal failure
32423	G222.00	Hypertensive renal disease with renal failure

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance placed on this supplemental material which has been supplied by the author(s)

BMJ Open

Medcode	Read_code	Description
35235	K04y.00	Other acute renal failure
48022	7L1Ay00	Other specified compensation for renal failure
53852	K05..12	End stage renal failure
53940	Kyu2100	[X]Other chronic renal failure
53945	Kyu2000	[X]Other acute renal failure
56760	7L1B.00	Placement ambulatory apparatus compensation renal failure
57919	K043.00	Acute drug-induced renal failure
59194	7L1By00	Placement ambulatory apparatus- compensate renal failure OS
61930	Kyu2.00	[X]Renal failure
63277	L393.00	Acute renal failure following labour and delivery
63760	SK05.11	Renal failure after crushing
64636	7L1Az00	Compensation for renal failure NOS
65089	7L1Cz00	Placement other apparatus- compensate for renal failure NOS
71314	L093.00	Renal failure following abortive pregnancy
72458	L393000	Post-delivery acute renal failure unspecified
83513	7L1C.00	Placement other apparatus for compensation for renal failure
96179	L393100	Post-delivery acute renal failure - delivered with p/n prob
97198	K044.00	Acute renal failure due to urinary obstruction
100205	K0E..00	Acute-on-chronic renal failure
101666	L070300	Unspecified abortion with renal failure
104857	K043000	Acute renal failure due to ACE inhibitor
105209	K045.00	Acute renal failure due to non-traumatic rhabdomyolysis
105267	K04B.00	Acute renal failure due to traumatic rhabdomyolysis
105739	K04..11	ARF - Acute renal failure
106860	C353600	Renal failure-associated hyperphosphataemia
107241	K043400	Acute renal failure induced by non-steroid anti-inflamm drug

15. Read codes to identify hypertension

Medcode	Read_code	Description
799	G20..00	Essential hypertension
1894	G201.00	Benign essential hypertension
2666	14A2.00	H/O: hypertension
3425	662O.00	On treatment for hypertension
3712	G20z.11	Hypertension NOS
4372	G202.00	Systolic hypertension

Medcode	Read_code	Description
7329	G24..00	Secondary hypertension
10818	G20z.00	Essential hypertension NOS
12680	8CR4.00	Hypertension clinical management plan
15377	G200.00	Malignant essential hypertension
16059	G24z.00	Secondary hypertension NOS
16565	6627	Good hypertension control
18482	662c.00	Hypertension six month review
18590	662b.00	Moderate hypertension control
19070	662d.00	Hypertension annual review
21826	662F.00	Hypertension treatm. started
25371	G241000	Secondary benign renovascular hypertension
27511	6628	Poor hypertension control
30776	6629	Hypertension:follow-up default
31387	G24z000	Secondary renovascular hypertension NOS
31755	G240.00	Secondary malignant hypertension
34744	G244.00	Hypertension secondary to endocrine disorders
42229	G24zz00	Secondary hypertension NOS
44549	L128.00	Pre-exist hypertension compl preg childbirth and puerperium
51635	G241z00	Secondary benign hypertension NOS
57288	G241.00	Secondary benign hypertension
59383	G240000	Secondary malignant renovascular hypertension
73293	G240z00	Secondary malignant hypertension NOS
83473	G203.00	Diastolic hypertension
85944	7Q01.00	High cost hypertension drugs
97533	Gyu2100	[X]Hypertension secondary to other renal disorders
98230	67H8.00	Lifestyle advice regarding hypertension
101649	7Q01y00	Other specified high cost hypertension drugs
102406	662P000	Hypertension 9 month review
102458	Gyu2000	[X]Other secondary hypertension
105274	G28..00	Stage 2 hypertension (NICE - Nat Ins for Hth Clin Excl 2011)
105316	G25..11	Stage 1 hypertension
105371	G25..00	Stage 1 hypertension (NICE - Nat Ins for Hth Clin Excl 2011)
105480	G27..00	Hypertension resistant to drug therapy
105487	G26..11	Severe hypertension

Medcode	Read_code	Description
105989	G26..00	Severe hypertension (Nat Inst for Health Clinical Ex 2011)
61166	G21z000	Hypertensive heart disease NOS without CCF
61660	G211000	Benign hypertensive heart disease without CCF
95334	G210000	Malignant hypertensive heart disease without CCF

16. Codes to identify open and closed tibial shaft fracture

Medcode	Read_code	Description
20678	S333200	Open fracture of tibia and fibula, shaft
28068	S333.00	Open fracture of tibia/fibula, shaft
28118	S333000	Open fracture shaft of tibia
28198	S333z00	Open fracture of tibia and fibula, shaft, NOS
28233	S33y.00	Open fracture of tibia and fibula, unspecified part, NOS
29084	S33y200	Open fracture of tibia and fibula, unspecified part
29164	S33y000	Open fracture of tibia, unspecified part, NOS

Medcode	Read_code	Description
971	S33x000	Closed fracture of tibia, unspecified part, NOS
4572	S33x200	Closed fracture of tibia and fibula, unspecified part
29109	S33x.00	Closed fracture of tibia and fibula, unspecified part, NOS
29121	S332.00	Closed fracture of tibia/fibula, shaft
33520	S332200	Closed fracture of tibia and fibula, shaft
34021	S332000	Closed fracture shaft of tibia
41971	S33xz00	Closed fracture of tibia and fibula, unspecified part, NOS
55464	S332z00	Closed fracture of tibia and fibula, shaft, NOS

OPCS-4	Description	Open/closed fracture
S571	Debridement of skin NEC	Open
W332	Debridement of open fracture of bone	Open
T963	Debridement of soft tissue NEC	Open
W336	Debridement of bone NEC	Open

ICD-10	Description	Open/closed fracture
T14.1	Open wound of unspecified body region	Open
T01.3	Open wounds involving multiple regions of lower limb(s)	Open
S81.7	Multiple open wounds of lower leg	Open

ICD-10	Description	Open/closed fracture
S81.8	Open wound of other parts of lower leg	Open
S81.9	Open wound of lower leg, part unspecified	Open
T93.0	Sequelae of open wound of lower limb	Open
T93.2	Sequelae of other fractures of lower limb	Open
T01.9	Multiple open wounds, unspecified	Open
T13.1	Open wound of lower limb, level unspecified	Open
T01.8	Open wounds involving other combinations of body regions	Open
T94.0	Sequelae of injuries involving multiple body regions	Open
T94.1	Sequelae of injuries, not specified by body region	Open
T12.1	Fracture of lower limb, level unspecified, open	Open

17. Read codes to identify Charlson comorbidity index

Microsoft Excel 2003
Worksheet

18. OPCS Codes to identify reoperations

OPCS-4	Description
W242	Closed reduction of fracture of long bone and rigid internal fixation NEC
O172	Remanipulation of fracture of long bone and rigid internal fixation NEC
O173	Remanipulation of fracture of long bone and flexible internal fixation HFQ
O175	Remanipulation of fragment of bone and fixation using screw
O178	Other specified secondary closed reduction of fracture of bone and internal fixation
O179	Unspecified secondary closed reduction of fracture of bone and internal fixation
W231	Secondary open reduction of fracture of bone and intramedullary fixation HFQ
W232	Secondary open reduction of fracture of bone and extramedullary fixation HFQ
W236	Secondary open reduction of fracture of bone and internal fixation HFQ
W248	Other specified closed reduction of fracture of bone and internal fixation
W249	Unspecified closed reduction of fracture of bone and internal fixation
W281	Application of internal fixation to bone NEC
W282	Adjustment to internal fixation of bone NEC
W283	Removal of internal fixation from bone NEC
W288	Other specified other internal fixation of bone
W289	Unspecified other internal fixation of bone

Supplemental material

BMJ Publishing Group Limited (BMJ) disclaims all liability and responsibility arising from any reliance
placed on this supplemental material which has been supplied by the author(s)

BMJ Open

OPCS-4	Description
W235	Secondary open reduction of fracture of bone and external fixation HFQ
W252	Closed reduction of fracture of bone and fixation using functional bracing system
W253	Remanipulation of fracture of bone and external fixation HFQ
W258	Other specified closed reduction of fracture of bone and external fixation
W259	Unspecified closed reduction of fracture of bone and external fixation
W301	Application of external fixation to bone NEC
W302	Adjustment to external fixation of bone NEC
W303	Removal of external fixation from bone NEC
W304	Application of external ring fixation to bone NEC
W308	Other specified other external fixation of bone
W309	Unspecified other external fixation of bone
W35.3	Removal of implanted substance from bone
W32	Other graft of bone
W32.1	Prepared graft of bone
W32.2	Allograft of bone NEC
W32.3	Xenograft of bone
W32.4	Synthetic graft of bone
W32.5	Cancellous chip allograft of bone
W32.8	Other specified other graft of bone
W32.9	Unspecified other graft of bone
S31.3	Revision of flap of skin NEC