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BMJ Open

Incidence of shoulder dislocations in the United Kingdom, 1995-2015: a population-based cohort study

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Primary Subject Heading:	Epidemiology
Secondary Subject Heading:	Sports and exercise medicine
Keywords:	shoulder dislocation, incidence, Clinical Practice Research Datalink, CPRD

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ABSTRACT

Objective

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METHODS

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RESULTS

Validation of the coding of shoulder dislocations within CPRD

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Incidence of shoulder dislocations in the UK

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Clinical Practice Research Datalink dataset dislocation READ codes used to identify shoulder dislocation patients

Dislocation or subluxation of shoulder	
Dislocation of shoulder NOS	
H/O: dislocated shoulder	
Closed reduction of dislocation of shoulder	!" #
Closed traumatic dislocation of shoulder	
Recurrent dislocation of shoulder – anterior	$ %#
Anterior dislocation of shoulder	
Recurrent joint dislocation, of shoulder region	$ %#
Recurrent subluxation of shoulder – anterior	$ %#
Closed traumatic dislocation shoulder jnt. Anterior (sub-coracoid)	
Closed traumatic dislocation shoulder joint, unspecified	
Closed traumatic subluxation, shoulder	&

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Word count: 2,763

Key words: shoulder dislocation, incidence, Clinical Practice Research Datalink, CPRD

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This cohort study evaluates the unknown age- and gender-specific incidence of primary shoulder dislocations in the UK.

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UK primary care data from the Clinical Practice Research Datalink (CPRD) were used to identify patients aged 16-70 years with a shoulder dislocation during 1995-2015. Coding of primary shoulder dislocations was validated using the CPRD general practitioner (GP) questionnaire service.

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A cohort of 16,763 shoulder dislocation patients aged 16-70 years during 1995-2015 were identified.

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Incidence rates per 100,000 person-years and 95% confidence intervals were calculated.

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Correct coding of shoulder dislocation within CPRD was 89% (95% CI: 83%-95%), and confirmation that the dislocation was a ‘primary’ was 76% (95% CI: 67%-85%). Seventy-two percent of shoulder dislocations occurred in men. The overall incidence rate in males was 40.4 per 100,000 person-years (95% CI: 40.4 to 40.4), and in

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females was 15.5 per 100,000 person-years (95% CI: 15.5 to 15.5). The highest incidence was observed in 16-20 year-old males (80.5 per 100,000 person-years; 95% CI: 80.5-80.6). Incidence in women increased with age to a peak of 28.6 per 100,000 person-years among those aged 61-70 years.

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This is the first time the incidence of shoulder dislocations has been studied using primary care data from a national database, and the first time the results for the United Kingdom have been produced. While most primary dislocations occurred in young men, an unexpected finding was that incidence increased in women aged over 50 years, but not in men. The reasons for this are unknown. Further work is commissioned by the National Institute for Health Research (NIHR) to examine treatments and predictors for recurrent shoulder dislocation.

" : The design of this study was approved by the Independent Scientific Advisory Committee (ISAC 15_260) for the Medicines & Healthcare products Regulatory Agency (MHRA).

"

- This is the first time the incidence of shoulder dislocations has been studied in the UK using a large population-based database from primary care.
- A new finding is that shoulder dislocations in women over the age of 50 years increased to a peak of 28.6 per 100,000 person-years in those aged 61-70 years

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- The coding of shoulder dislocation diagnoses was validated by comparison with medical records, using a GP questionnaire.
- The validation exercise did only include the 16-35 years age group, however there is no reason why coding of shoulder dislocations would be different for patients aged up to 70 years.
- While not all GP practices responded to the questionnaire, those that did and did not respond were similar by deprivation, geography and other demographic characteristics.

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Shoulder joint dislocations are the most common joint dislocations seen in hospital Accident and Emergency departments and trauma clinics [1, 2] with 80-97% of traumatic glenohumeral dislocations being anterior. [1-6] Traumatic anterior shoulder dislocation most commonly occurs after traumatic injury in young people and usually results in structural problems such as Bankart lesions [7] and the Hills-Sachs lesion [5]. The joint can remain 'unstable' and re-dislocation rates have been reported as being as high as 85% [8] or 92% [9] in young people. Surgery is becoming more common as a treatment, especially in sporting athletes, with many surgeons and patients opting for surgery after only one dislocation.

A Swedish population-based study was conducted by Hovelius. [10] This study while small is well cited in the literature, and observed that 1.7% of the population aged 18-70 years had had a shoulder dislocation. In a 25-year follow-up study of patients aged 12-40 years, recurrent dislocation was more common in younger people with 72% of patients aged 12-22 years suffering another dislocation, which dropped to 27% in those aged 30-40 years. [11] Early studies reported high incidence of shoulder dislocation in military and athletic populations, with young men being at greatest risk. [6, 12-15] In Edinburgh, a study of 252 patients aged 15-35 years suffering a shoulder dislocation identified the most common cause (86%) was playing contact sports. [16] Of these 60% suffered a repeat dislocation and the mean time for recurrent dislocation to occur was 13.3 months.

A number of studies report incidences ranging from 11.2 to 26.2 per 100,000 person-years for shoulder dislocations. [2, 17-21] In 2010, Zachilli & Owens [19] examined the

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incidence of traumatic shoulder dislocation in patients of all ages presenting to a random sample of 100 hospital emergency departments across the USA during 2002-2006, as recorded in the National Electronic Injury Surveillance System. Seventy-two per cent of dislocations had occurred in men, and the highest incidence was observed in 20-29 year olds (47.8 per 100,000 person-years; 95% CI: 41.0-54.5). The overall incidence rate in males was 34.9 per 100,000 person-years (95% CI: 30.1 to 39.7), and in females was 13.3 per 100,000 person-years (95% CI: 11.6 to 15.0).

In 2014, Leroux et al. [22] evaluated the incidence of primary anterior shoulder dislocation in patients aged 16-70 years who underwent a closed reduction of the shoulder during April 2002 – September 2010 in Ontario, Canada. Seventy-four per cent of all shoulder dislocations were in men, and the highest incidence was observed in men aged 16-20 years (98.3 per 100,000 person-years). The overall adjusted incidence in men and women were similar to figures reported by Zachilli & Owens. [19]

The incidence of primary anterior shoulder dislocations has not been examined using all patients in a national dataset. The incidence of shoulder dislocations in the UK remains unknown and a large population-based UK study has not been previously undertaken.

The aim of this study was to evaluate the age- and gender-specific incidence of primary shoulder dislocations as recorded in primary care during the 20-year period between 1995 and 2015 in the United Kingdom.

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Population-based primary care data from the Clinical Practice Research Datalink (CPRD) were used to identify a cohort of patients with a shoulder dislocation aged 16-70 years during 1995-2015 in the UK. The design of this study was approved by the Independent Scientific Advisory Committee (ISAC 15_260) for the Medicines & Healthcare products Regulatory Agency (MHRA).

The CPRD covers 11.3 million people from 674 UK general practices, with a current representative coverage of approximately 6.9% of the UK population who are broadly representative of the UK population in terms of age, sex and ethnicity.[23] While the data are anonymised at the patient and general practice level, demographic information at the patient level on age, gender, geographic region, body mass index (BMI, kg/m^2), smoking status (current smoker, ex-smoker, and non-smoker) and drinking status (current drinker, ex-drinker, and non-drinker) were available. Data on the Index of Multiple deprivation 2004 [24] for English patients were linked with the CPRD data. Charlson co-morbidity score was calculated using a list of pre-defined CPRD READ codes. CPRD population denominators for the whole CPRD dataset by individual year, age and gender were also obtained.

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Shoulder dislocations were identified using READ codes as defined *a priori* after consensus by specialist shoulder clinicians experienced in clinical practice and epidemiological research (Supplementary table A). To ensure that only primary

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shoulder dislocations had been captured, patients had to have no recorded shoulder dislocations in the two years of clinical data (a 2-year wash-out period was defined using the date the GP practice was classified as 'up-to-standard' and the date the patient first registered at the GP practice) preceding the identified shoulder dislocation. A pre-defined set of exclusion criteria were applied to the CPRD dataset (Figure 1).

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A separate internal validation exercise of the coding of shoulder dislocations within CPRD was conducted among patients aged 16-35 years who were diagnosed during 1 April 1997-31 March 2015 in England using the same READ codes for shoulder dislocations, as well as the same two-year wash-out period. The age range used for this validation exercise was not entirely inclusive of the present study, but tested the same coding used in the older age group. The 16-35 years age range was used to inform both this study and a future commissioned study that will include linked hospital data among patients aged 16-35 years because this group currently have the highest level of priority for clinical interventions.

A GP questionnaire was designed based on a validation algorithm (Supplementary figure B) and with the assistance of GPs. A random sample of 172 patients was selected and CPRD personnel sent the questionnaire to the patient's GP practice for a clinician to complete by comparing the records on their CPRD system with the patient's clinical records. Four written reminders were sent every two weeks to the GP practices. Data from the questionnaires were double-entered into a dataset by a

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statistician and a project manager, and queries were resolved by an academic orthopaedic shoulder surgeon.

The following validation criteria were stipulated *a priori* for proceeding with shoulder dislocation research studies using CPRD data:

a) A positive predictive value of accurate shoulder dislocation coding within CPRD of at least 75%.
b) A positive predictive value of accurate 'primary' or 'first-time' shoulder dislocation coding within CPRD of at least 75%.

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Descriptive statistics were used to summarise the epidemiology of primary shoulder dislocations by demographic factors. Incidence rates by age and gender per 100,000 person-years and incidence rate ratios with 95% confidence intervals and p values were calculated using STATA v14.1.[25]

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A random sample of 172 patients aged 16-35 years in England within the CPRD dataset were selected from a total of 6,046. Of these 172, GPs returned the validation questionnaire for 95 (55%) patients. For an additional two patients GPs confirmed that the patient had transferred out of the practice and no medical records or information on the CPRD system were available for them. The demographic characteristics of: (a) the CPRD cohort aged 16-35 years during 1 April 1997 – 31

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March 2015 in England (n=6,046), (b) of the 172 patients randomly selected to have a questionnaire sent to their GP for additional information, and (c) responders and (d) non-responders to the GP questionnaire are given in Table 1.

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Table 1: Demographic characteristics of shoulder dislocation patients aged 16-35 years recorded within the Clinical Practice Research Datalink dataset during 1 April 1997-31 March 2015 in England, and responders and non-responders to the CPRD GP validation questionnaire

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Cohort size	6,046	172	97	75
Gender				
- Male	4,991 (83%)	137 (80%)	81 (84%)	56 (75%)
- Female	1,055 (17%)	35 (20%)	16 (16%)	19 (25%)
Median age (years) & interquartile range	24 (20-34)	24 (20-29)	24 (20-29)	24 (19-29)
Median BMI (kg/m^2) & interquartile range	24 (22-27)	24 (21-27)	25 (22-28)	23 (21-26)
Median Charlson co-morbidity index & interquartile range	0 (0-0)	0 (0-0)	0 (0-0)	0 (0-0)
Region				
- East Midlands	263 (4%)	0 (0%)	0 (0%)	0 (0%)
- East of England	673 (11%)	21 (12%)	17 (18%)	4 (5%)
- London	695 (12%)	23 (13%)	11 (11%)	12 (16%)
- North East	133 (2%)	4 (2%)	3 (3%)	1 (1%)
- North West	951 (16%)	29 (17%)	13 (13%)	16 (21%)
- South Central	965 (16%)	32 (19%)	17 (18%)	15 (20%)
- South East Coast	702 (12%)	25 (15%)	12 (12%)	13 (17%)
- South West	743 (12%)	17 (10%)	17 (18%)	0 (0%)
- West Midlands	667 (11%)	15 (9%)	7 (7%)	8 (11%)
- Yorkshire & the Humber	254 (4%)	6 (3%)	0 (0%)	6 (8%)
Index of Multiple Deprivation 2004				
- Affluent	1,279 (21%)	53 (31%)	28 (29%)	26 (35%)
- 2	1,077 (18%)	35 (20%)	20 (21%)	15 (20%)
- 3	958 (16%)	24 (14%)	16 (16%)	8 (11%)
- 4	876 (14%)	38 (22%)	19 (20%)	18 (24%)
- Deprived	624 (10%)	22 (13%)	14 (14%)	8 (11%)
- Missing	1,232 (20%)	0 (0%)	0 (0%)	0 (0%)

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AS analysed the data and drafted the paper. AJ assisted with the analysis and commented on the paper. AD assisted with managing and cleaning the data, and commented on the paper. KE assisted with the literature review, data access, the internal validation study, and commented on the paper. NKA, DPA, AJC, TAH, RPV, SH, SEL, AR, GSC commented on the paper. JR designed the study, oversaw the analysis and revised the paper.

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AS, AD, KE, AJC, RPV, SH, SL, GSC and JR have no competing interests to declare.

AJ has received a grant from NIHR HS&DR during the conduct of the study, and has received consultancy, lecture fees and honoraria from Servier, UK Renal Registry, Oxford Craniofacial Unit, IDIAP Jordi Gol, Freshfields Bruckhaus Deringer, has held advisory board positions (which involved receipt of fees) from Anthera Pharmaceuticals, INC., and received research sponsorship from ROCHE.

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NKA has received honoraria, held advisory board positions (which involved receipt of fees) and received consortium research grants from Merck (honorarium); Roche, Novartis and Bioiberica (grants); Smith & Nephew, Nicox, Flexion Bioventus and Freshfields (personal fees) outside the submitted work.

DPA has received research grants from Amgen and Laboratoires Servier.

TH is a GP in London, and is a GP advisor for, but not employed by, the Clinical Practice Research Datalink (CPRD).

AR has received personal fees from DePuy Ltd., Aviva Health, AXA PPP Healthcare, AXA PPP International, BUPA, Cigna, SecureHealth, Simplyhealth, Vitality Health (Pru Health) and WPA; a grant from JRI Ltd.; and has a patent for a shoulder replacement prosthesis.

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This study was approved by the Independent Scientific Advisory Committee (ISAC) for the UK Medicines and Healthcare products Regulatory Agency (MHRA) (ISAC Approval Number 15_260RAR).

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necessarily reflect those of the HTA programme, NIHR, NHS or the Department of Health. All researchers are independent from the study funders. This study is based in part on data from the Clinical Practice Research Datalink obtained under licence from the UK Medicines and Healthcare products Regulatory Agency. The funding source had no role in the design and conduct of the study, in the collection, analysis and interpretation of the data, or in the preparation, review or approval of the manuscript.

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Figure 1: Shoulder dislocation exclusion flow chart for patients aged 16-70 years during 1995-2015 within the Clinical Practice Research Datalink, UK.

Figure 2: Percentage of primary shoulder dislocation patients by age (16-70 years) and gender recorded within the Clinical Practice Research Datalink during 1995–2015, UK. Blue bars represent male patients, and red bars represent female patients.

Legend: 95% confidence intervals are included in this figure, but they are so close to the main data points that they cannot be seen.

Figure 3: Shoulder dislocation incidence rates by age and gender during 1995-2015 in the UK, using data from the Clinical Practice Research Datalink.

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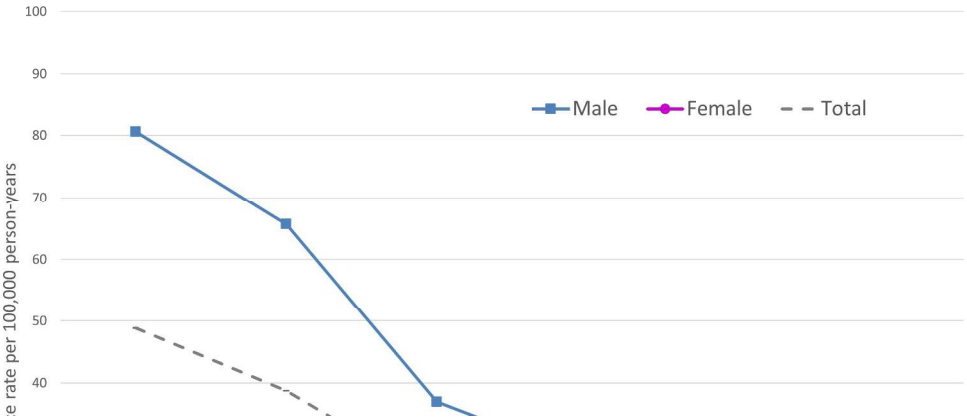

Figure 3: Shoulder dislocation incidence rates by age and gender during 1995-2015 in the UK, using data from the Clinical Practice Research Datalink. Legend: 95% confidence intervals are included in this figure, but they are so close to the main data points that they cannot be seen.

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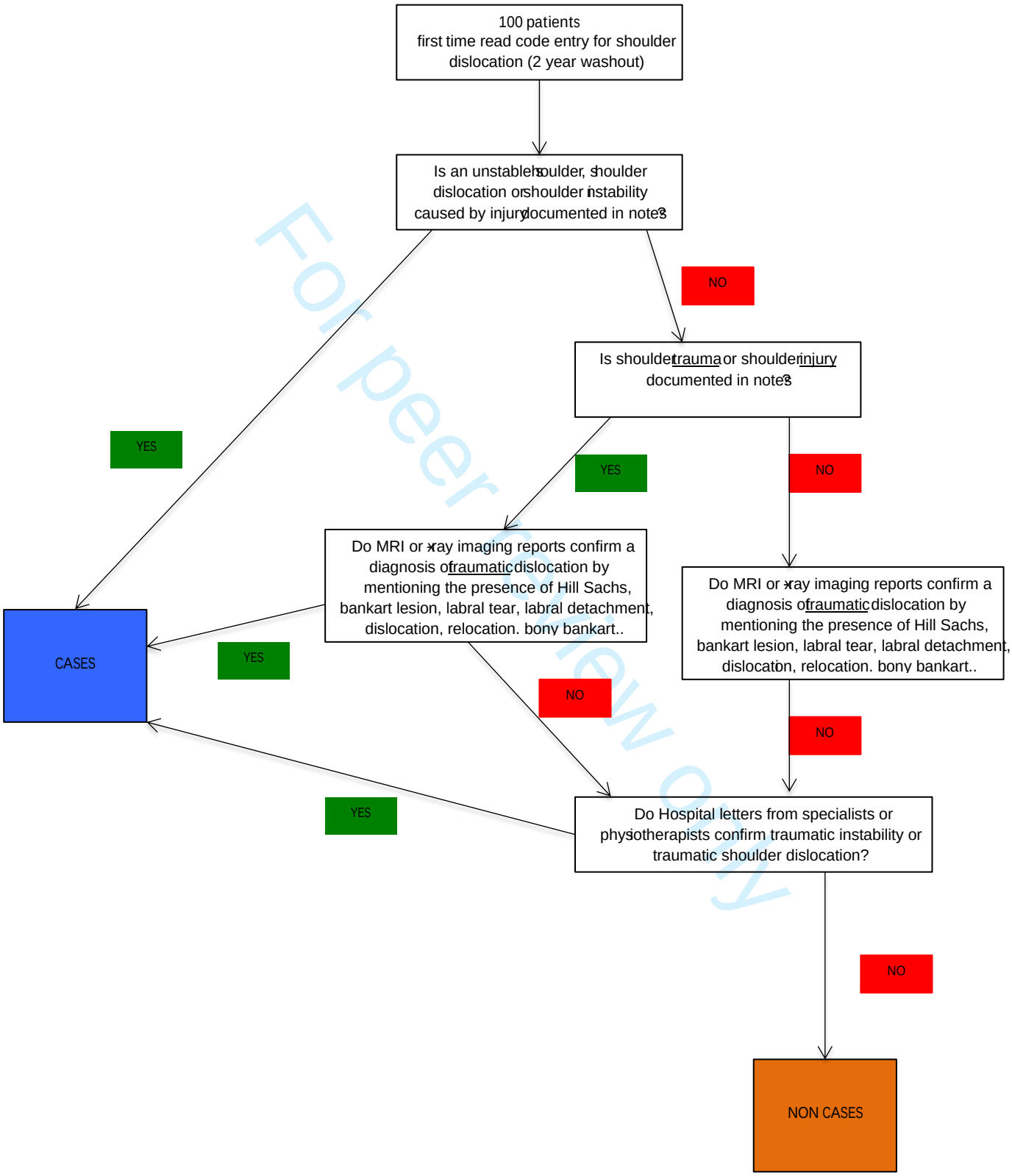
Validation Algorithm



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STROBE Statement—checkl

	Item No
Title and abstract 'Cohort' page 1 and page 3	1
Introduction	
Background/rationale page 6	2
Objectives page 7	3
Methods	
Study design page 9	4
Setting pages 9-10	5
Participants pages 9-10	6
	N/A
Variables page 9	7
Data sources/ measurement page 9	8*
Bias pages 10-11	9
Study size page 31	10
Quantitative variables page 9	11
Statistical methods page 11 Only descriptive statistics and incidence rates. No multivariate analysis or follow-up needed.	12 N/A N/A N/A N/A

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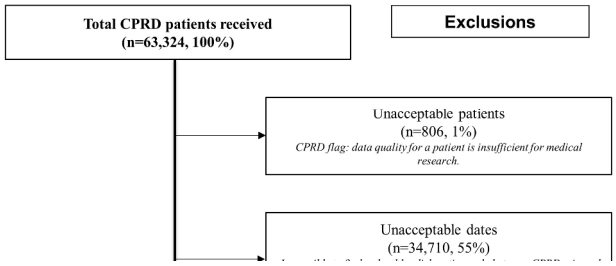

Figure 1: Shoulder dislocation exclusion flow chart for patients aged 16-70 years during 1995-2015 within the Clinical Practice Research Datalink, UK.

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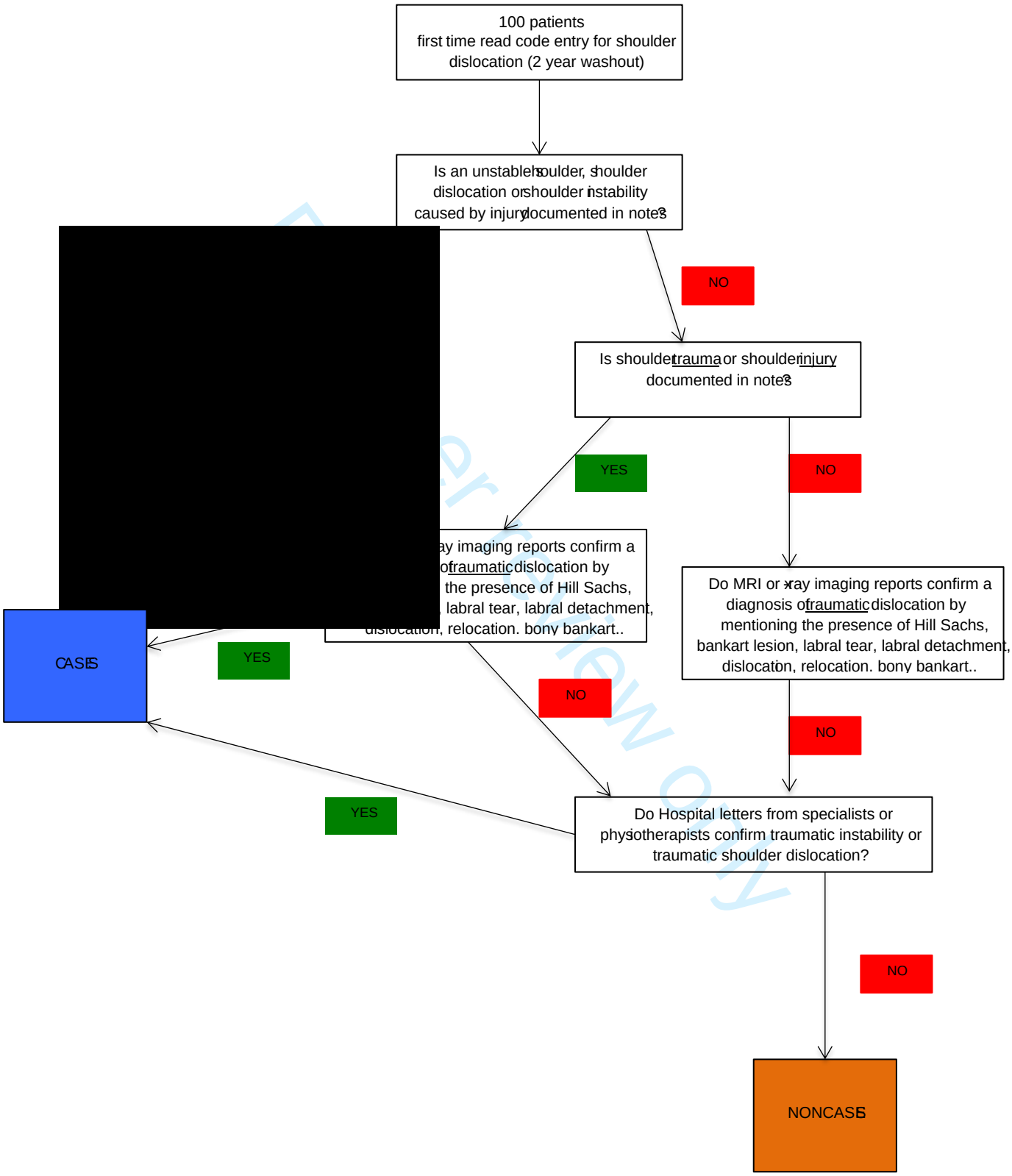
Validation Algorithm



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STROBE Statement—checklist of items that shou

	Item No	
Title and abstract 'Cohort' page 1 and page 3	1	(*a*) Indicate the study's
		(*b*) Provide in the abstr and what was found
Introduction		
Background/rationale page 6	2	Explain the scientific b
Objectives page 7	3	State specific objective
Methods		
Study design page 9	4	Present key elements o
Setting pages 9-10	5	Describe the setting, lo exposure, follow-up, ar
Participants pages 9-10	6	(*a*) *Cohort study*—Give selection of participant *Case-control study*—G case ascertainment and and controls *Cross-sectional study*— selection of participant
	N/A	(*b*) *Cohort study*—For exposed and unexposed *Case-control study*—F controls per case
Variables page 9	7	Clearly define all outco modifiers. Give diagno
Data sources/ measurement page 9	8*	For each variable of in assessment (measureme is more than one group
Bias pages 10-11	9	Describe any efforts to
Study size page 31	10	Explain how the study
Quantitative variables page 9	11	Explain how quantitati describe which groupin
Statistical methods page 11 Only descriptive statistics and incidence rates. No multivariate analysis or follow-up needed.	12	(*a*) Describe all statistica
	N/A	(*b*) Describe any method
	N/A	(*c*) Explain how missing
	N/A	(*d*) *Cohort study*—If app *Case-control study*—If a addressed *Cross-sectional study*— sampling strategy
	N/A	(*e*) Describe any sensitiv

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Results		
Participants	13*	pages 11, 15 and 31 Figure 1.
Descriptive data	14*	pages 11-17
Outcome data	15*	pages 17-19
Main results	16	pages 11-19 pages 32-33 for Figures
Other analyses	17	N/A
Discussion		
Key results	18	page 20
Limitations	19	page 22
Interpretation	20	pages 20-21
Generalisability	21	pages 20-21
Other information		
Funding	22	pages 25-26

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