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ABSTRACT

Following an outbreak of measles across South West England in 2016, the multi-agency outbreak control team suggested that immunisation history for the health protection response may not be reliable. We undertook a cross-sectional study to compare measles immunisation records collected from outbreak cases on the case management system HPZone by the Health Protection Team with the full primary care record.

A total of 122 cases were reported. We identified 86.9% cases were not fully immunised and 5.7% had an unknown immunisation status. There were 14 cases whose primary care records did not match HPZone, and 18 cases where primary care records were available and immunisation status was not documented in HPZone. Complex, non-linear associations were found between age and socioeconomic deprivation status of each case and having an incorrect HPZone record. Cases who resided in postcode areas of greater socioeconomic deprivation had statistically significantly higher odds of having been fully immunised. Only 13.3% of partially or unimmunised cases received an MMR immunisation following their onset of measles infection.

Collecting immunisation status from the full primary care record during acute management of measles cases may support improvements in control and prevention of further cases.

KEYWORDS

Measles, MMR, immunisation status, immunisation record, record accuracy, health protection

BACKGROUND

During 2016, a measles outbreak occurred across South West England (le Polain de Waroux et al., 2016). On notification of a measles case, immunisation status is recorded by the Health Protection Team generally using verbal report from a clinician, the case or their proxy.

The multi-agency outbreak control team suggested that completeness of immunisation status data was suboptimal and not entirely reliable. Child Health Information Systems (CHIS) are locally commissioned to collect and maintain clinical and demographic data including immunisation records. CHIS exchange data with electronic clinical systems used by GP practices. CHIS records are considered less reliable for children over five years including those who have migrated area, changed practice after vaccination, and who are not registered with CHIS (Simone et al., 2014).

The aim of this study was to compare measles immunisation records collected by the Health Protection Team with the 'gold standard' full primary care record for cases included in the 2016 South West England outbreak.

METHODS

A cross-sectional study was undertaken. All cases reported to Public Health England from 25 May 2016 to 31 October 2016 were included. National guidelines were used to define cases of probable (clinical suspicion) and confirmed (laboratory confirmed) measles (Public Health England, 2017b).

Existing data on cases was extracted from the case management system HPZone. Primary care record data was requested in July 2017 from the GP practice for each case using SelectSurvey (a secure online survey tool). Data items collected included case demographics, GP practice characteristics and immunisation status. We defined cases as 'immunised' for individuals who had received two MMR immunisations, 'partially immunised' for individuals who had received a single dose of MMR, 'unimmunised' for individuals who had received no MMR immunisations, and 'unknown' for individuals with no primary care record of immunisation against measles. Receipt of monovalent measles vaccine was not considered to equate to full or partial immunisation since the outcome measure used in this study was receipt of MMR immunisation, in accordance with national guidelines (Public Health England, 2017a).

The data was cleaned and coded for analysis. Statistical analyses were carried out using STATA version 13 (StataCorp, College Station, TX, USA). Case demographics and immunisation status variables obtained from HPZone and primary care records were described and compared. Fisher's exact test was used to statistically test for differences between the two data sources. Univariate analyses were undertaken to estimate odds ratios (ORs) as measures of association between relevant independent variables and (1) having an incorrect HPZone record, and (2) cases identified as fully immunised. Ninety-five percent confidence intervals and p-values were calculated. The assumption of a linear association between continuous independent variables and outcomes was tested by fitting functions and the Wald or likelihood ratio test. Inclusion of variables to account

for clustering by GP practice and family were explored. Independent variables with ORs >1 and p-values of association <0.2 from univariate analyses were included in a multivariable logistic regression model. Ethical committee clearance was not required for this study.

RESULTS

Descriptive analysis

A total of 122 cases were identified (94 confirmed and 28 probable). 62% were males, age ranged from 0 to >50 years (median age category 10-20 years), index of multiple deprivation (IMD) score ranged from 1.5 to 66.7 (median 16.4). Data available suggested that the majority of cases were white and UK born. The median GP practice list size was 13,000 patients (range 3,200-37,500); 14.4% of cases with available data had registered with the practice <2 years before the measles outbreak. A response rate of 85% (n=97) was achieved from GP practices after excluding eight cases who lived abroad or were not registered with a practice.

Table 1 presents the data held on immunisation status in HPZone records and primary care records. The merged record column describes immunisation status of cases using data from both sources, with priority given to primary care records. A total of 86.9% of cases were not fully immunised, the majority being completely unimmunised (although five were infants and not eligible). A further 5.7% of cases had an unknown immunisation status. Only 13.3% of partially or unimmunised cases received an MMR immunisation following their onset of measles infection. Two cases had received monovalent measles immunisation.

Table 2 presents the immunisation status recorded for each case according to each data source. There were 14 cases whose full primary care records did not reflect the immunisation status recorded in HPZone. Six cases recorded as partially vaccinated in HPZone were found to be completely unimmunised. Eight cases were recorded as unvaccinated in HPZone but full primary care records showed that two were fully immunised, five had a single dose of MMR and one had monovalent vaccine. Full primary care records were available for 18 cases with no immunisation status available in HPZone; 13 had not been immunised and 5 had been fully immunised. We identified a statistically significant difference in the immunisation status data between HPZone and primary care records.

Analysis of association with case having an incorrect HPZone record

Once clustering by GP practice or family was accounted for, the association of both age and IMD score with an incorrect HPZone record was statistically significant. No clear inference can be made on the direction of the effects since the relationship was non-linear and at least as complex as a cubic function for age and a quadratic function for the IMD score. Sex, GP practice size and recent registration with the GP practice of a case were not significantly associated. Inclusion of age and IMD score and clustering in a multivariable regression model did not alter the pattern of association.

Analysis of association with case being fully immunised

Whilst sex, age, GP practice size and recent registration with the GP practice were not significantly associated with the case's immunisation status, when clustering by GP practice or family was accounted for there was evidence that people who resided in postcode areas of greater socioeconomic deprivation had higher odds of having been fully immunised.

DISCUSSION

We identified evidence of a statistically significant difference in HPZone and primary care records of measles immunisation among cases linked to the 2016 South West England outbreak. Current health protection practice allows for immunisation status to be given verbally by a clinician, the case, or their proxy since guidelines do not require this to be obtained from the full primary care record (Public Health England, 2017b). We postulate that reporting source, sociodemographic characteristics (including age and country of birth), knowledge of current and historical measles vaccination policy on part of the public health practitioner and population coverage are important factors when eliciting immunisation history.

This finding has important implications during acute management. Health Protection Teams will undertake risk assessments and make recommendations that catch-up vaccinations are sought where an individual and their household are not fully immunised in line with the routine schedule. Accurate immunisation status alongside demographic information can help direct action through reducing the risk of spread, protecting against subsequent infection, ensuring appropriate use of finite resources and reducing health inequalities. Furthermore, an elevated incidence of measles among immunised groups may prompt investigation and recognition of immunisations potentially associated with reduced clinical effectiveness. Timely access to the full primary care record should be considered in context of the need for rapid public health action during acute response to a case of measles. Depending on local procedural arrangements, our findings will likely be applicable to other areas of England and potentially other countries.

Whilst generally children from the most socioeconomically deprived communities have consistently had the lowest MMR uptake nationally, families who continue to reject MMR tend to have more advantaged backgrounds and make a conscious decision to not immunise early on (Hungerford et al., 2016; Pearce et al., 2013). A socio-demographic analysis of unvaccinated residents across the South West would provide additional evidence to guide actions intended to target sub-groups with low MMR uptake.

This study has some important caveats. Since immunisation uptake in children is inherently dependent on parents or carers, bias could be introduced if family context is not accounted for. There may be a systematic difference in completeness and quality of records between different GP practices which could over or underestimate immunisation uptake. Whilst we attempted to address this by including cluster variables, the analysis was not statistically powered to explore this. The limited number of cases within the dataset including across some variables and strata reduced both the precision around point estimates and the number of independent variables which could be included in adjusted analyses to avoid model overfitting. We did not recruit control or reference subjects and therefore any inference cannot be made regarding immunisation

effectiveness. It should be noted that immunisation status history collected in national surveillance data is undertaken centrally and is not based on HPZone records.

CONCLUSION

Collecting immunisation status from the full primary care record during acute management of measles cases may support improvements in control and prevention of further cases. Further analyses are indicated to identify opportunities to improve targeted uptake of MMR vaccines.

CONTRIBUTORSHIP

CB and JY conceived the study. JM was involved in protocol development, protocol implementation and data analysis. NV provided expert input on the statistical analyses. JM wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

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DECLARATION OF CONFLICTING INTERESTS

The Authors declare that there is no conflict of interest.

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