Vaccine-preventable disease susceptibility in a British paediatric assessment unit

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Abstract

Aims: To evaluate practice within a paediatric secondary-care centre before and after introduction of simple interventions to improve identification of under-immunised children and facilitate catch-up immunisations. **Methods:** The population-based child health database was used to check immunisation status for two cohorts of 200 consecutive admissions before and after routine printing of immunisation histories from the database and raising staff awareness. Vaccine-preventable disease (VPD) susceptibility burdens were calculated for each child. Case notes were assessed for accuracy and documentation of ward-based interventions. **Results:** Fourteen per cent of all children were under-immunised on admission and 27% of these were more than five years behind schedule. Under-immunised children's VPD susceptibility burdens ranged from 0–40,858 days and in 59% exceeded 1,000 days. Over one month the paediatric admission unit saw children with a combined VPD susceptibility burden of 1,323 child-years. Positive identification of under-immunised children increased by 40% (95% confidence interval: 12–62, $p=0.002$) following the introduction of routine database printouts. **Conclusion:** Children presenting to British secondary care units have large VPD susceptibility burdens. Positive identification of under-immunised children substantially improved after the introduction of routine database printouts, but catch-up immunisation rates did not increase.

Introduction

Persistent outbreaks of vaccine-preventable illnesses across the developed world, including recent UK outbreaks of measles and pertussis (Council for Foreign Relations, 2013) underline the importance of attaining and maintaining high immunisation rates. Decades of domestic and international recommendations from bodies such as the

World Health Organization (2013; Hutchins et al, 1993), the National Institute of Health and Care Excellence (NICE) (2009), the Health Protection Agency (2012, 2013), Public Health England (2014) and the UK Department of Health (2003, 2004, 2006) have all advocated the provision of opportunistic immunisations in every clinical setting. A growing body of evidence demonstrates that tertiary paediatric units can play a useful role in identifying under-immunised children and facilitating catch-up immunisations (Ferson, 1990; Bell et al, 1997; Conway, 1999; Walton et al, 2007; Ressler et al, 2008; Blair, 2010; Gandhi et al, 2011; Shingler et al, 2012).

Inpatients represent a relatively disadvantaged, vulnerable and under-immunised group compared with the general childhood population (Conway, 1999; Walton et al, 2007; Shingler et al, 2012). The advent of electronic population-based child health information systems (CHIS) has simplified the task of identifying these under-immunised children. Immunisation is often inappropriately deferred due to minor illness (Riley et al, 1991; Walton et al, 2007) and significant numbers of parents who decline immunisation for their children in the community agree to vaccination in hospital (Walton et al, 2007; Berling et al, 2012).

Accurate immunisation documentation is the foundation of any opportunistic immunisation service (Crawford and Buttery, 2008; Shingler et al, 2012) and five UK studies from large urban centres have piloted schemes to improve identification of under-immunised paediatric patients and facilitate catch-up immunisation (McKinlay and Rankin, 1991; Riley et al, 1991; Conway, 1999; Walton et al, 2007; Gandhi et al, 2011). These studies reported under-immunisation status in 13–40% of inpatients, with 3–75% of parents agreeing to catch-up immunisation prior to discharge. Walton and colleagues (2007) report that only one UK hospital has a routine opportunistic immunisation system in place and there is no data from secondary-care centres where the majority of paediatric patients are seen, or from more rural areas where immunisation levels are often higher (Gilbert and Wrigley, 2009).

Table 1. Cohort characteristics

Total number of children	400
Age range (mean)	2m–15.8y (5.3y)
Male:Female	2:1
Under-immunised children (%)	56 (14%)
Median days behind schedule (range)	381 (0–5,670)
Total days behind schedule for cohort	66,689
Median individual VPD susceptibility burden* days (range)	2,009 (0–40,858)
Total days VPD susceptibility burden for cohort* days	483,369

*See Methods for definition. VPD: vaccine-preventable disease

Table 2. Pre/post intervention findings

	Stage 1	>Stage 2	Change
Number of children	200	200	-
Number eligible for vaccination on date of assessment	30	26	-
Missing immunisations correctly documented in notes	5 (17%)	15 (58%)	+41% (95% CI; 12–62) $p=0.002$
Full immunisation history documented in notes	0 (0%)	8 (31%)	+31% (95% CI; 9–31) $p=0.001$
Ward-based plan documented in notes	1 (3%)	6 (23%)	+20% (95% CI; -1–27) $p=0.026$
Immunisations given prior to discharge	0 (0%)	0 (0%)	0
Outstanding immunisations mentioned in GP discharge letter	0 (0%)	13 (50%)	+50% (95% CI; 27–50) $p=n/a$
Received outstanding immunisations within five months of admission	13 (43%)	9 (35%)	- 8% (95% CI; -35–20) $p=0.5$

We implemented a series of measures in line with NICE recommendations (2009) to ensure that our Cornish district general hospital was not missing opportunities to increase immunisation cover.

Aims

1. To establish the proportion of children presenting to a secondary-care paediatric admissions unit who are under-immunised.
2. To estimate the burden of susceptibility to vaccine-preventable diseases (VPD) among children presenting to the unit.
3. To introduce and evaluate a simple system to improve identification of under-immunised children and facilitate completion of the immunisation schedule.

Methods

Study design – Pre/post-intervention audit.

Stage 1

The population-based CHIS was used to check immunisation status for every child assessed in the paediatric unit from 1 January 2013 until we had 200 consecutive admissions for whom immunisation status could be verified. This was compared with the vaccination history documented in the notes. We recorded whether a child was eligible for immunisation on the date of admission and, where any immunisations were missing (i.e. the child was 'under-immunised'), how many days had elapsed since the child became eligible for the first overdue dose. We calculated individual VPD susceptibility burdens as the cumulative total of elapsed days for each VPD. For example a 5 year-old who had not received the combined measles, mumps and rubella vaccines (MMR) would be four years behind schedule and have a VPD susceptibility burden of 12 years.

We also recorded any documented interventions on the wards (discussion with parents, provision of information leaflets, immunisation)

and whether under-immunisation had been mentioned in the discharge letter to GPs. Immunisation status was re-checked on the CHIS five months after the date of admission.

In a semi-structured discussion we asked senior paediatricians about potential barriers to opportunistic in-patient immunisation. Responses were coded using simple thematic analysis.

Approval was obtained from the hospital audit department, and research ethical approval was not required.

Interventions

1. Ward clerks printed full vaccination histories from the CHIS and filed them in admission documents.
2. Admitting doctors were encouraged to use this data (in conjunction with parental report) to identify and record outstanding immunisations, counsel parents and offer immunisation where appropriate or ask GPs to arrange catch-up immunisations in discharge letters.
3. The current immunisation schedule, parent information leaflets and guidelines for accessing the database out of hours were made available in the doctors' office on paper and in electronic format.

Stage 2

Immunisation status, documentation and interventions were re-audited for a second cohort of 200 consecutive patients one week after the measures were introduced (June 2013) using the same procedure and as stage 1.

Results

The children's characteristics and study results are summarised in Tables 1–3. Ninety-five per cent of all children had immunisation data available on the CHIS. Immunisation reporting delays resulted in three children being incorrectly coded as under-immunised on

Table 3. Percentage of all admissions missing ≥ 1 dose of specific immunisations

IPV	11.5%
DTap	10.0%
Hib	9.5%
PCV	9.0%
MenC	9.0%
MMR	8.0%
HPV	1%
Td/IPV booster	1%

the CHIS in the second cohort. As these 'false positives' would skew the analysis their values were excluded. The two cohorts from January and June were similar in terms of age, sex and daily admission rate.

The 400 children presented over a 31 day period and only one child's CHIS record indicated lack of consent to immunisation. Fourteen per cent of patients (just under two per day) were eligible for immunisation on the date of assessment. The period of time behind schedule ranged from 0 days (i.e. became eligible on the date of assessment) to 15.5 years, and amounted to 183 child-years for the entire cohort. The average under-immunised child was over a year overdue and 27% were over five years behind schedule. Eleven children had been eligible for less than a month and all received catch-up immunisations 10–108 days later. None of the children who were over a year overdue on admission had received all of their catch up immunisations at the five-month follow up.

Missing immunisations were spread fairly evenly across the pre-school schedule (Table 3) and only one child lacked a single immunisation. Individual VPD susceptibility burdens varied considerably (0–40,858 days), but exceeded 1,000 days in 61% of under-immunised children (Figure 1). Over 31 days the paediatric admission unit saw children with a combined VPD susceptibility burden of 483,369 child-days – over 1,300 child-years.

Introduction of the immunisation-focused interventions was followed by a substantial increase in positive identification of children eligible or overdue for immunisation, as well as in the proportion of children with a full immunisation history recorded in the medical notes and the proportion with immunisation status documented in the discharge letter (see Table 2). This improvement was not accompanied by any increase in the numbers of children immunised pre-discharge. At five-month follow up there was no significant difference in catch-up immunisation rates between the two cohorts.

Discussion with the paediatric team identified several possible barriers to inpatient opportunistic immunization, including perceptions that administration of immunisations lies beyond the remit of secondary care; that side-effects of immunisation may delay discharge and increase re-admission rates; that many children may have a contraindication or parents who decline immunisation; and that staff lack the training and time to take on additional immunisation-related tasks.

Discussion

To our knowledge this is the first UK study to examine under-immunisation in the hospital setting where most acute paediatric patients are seen. We found that under-immunisation rates were comparable to reports from international tertiary centres and three times higher than local community rates. Compared with Public Health England immunisation data for the same period (2013) our population shows significantly lower rates of immunisation coverage than the regional and

Figure 1. Individual VPD susceptibility burdens

national paediatric populations. The magnitude of individual and cumulative VPD susceptibility is striking.

The CHIS provided an incorrect vaccination history for three children (0.0075%), all of whom had recently moved to the area. Computerised records are a powerful tool but they are not infallible and should always augment parental history.

Significant improvements in detection and notification of eligible children did not in themselves lead to opportunistic inpatient immunisation, or increase the likelihood of catch-up immunisation within five months of admission. This implies that other issues need to be addressed if identification of under-immunised children is to be translated into pre-discharge immunisation. Potential barriers identified by the paediatric team correlate with the finding of other researchers (Conway, 1999; Walton et al, 2007; Gilbert and Wrigley, 2009) and are largely unfounded. Studies spanning back to the early 1990s have demonstrated that accessing central databases is straightforward, very few children have absolute contraindications to immunisation, and large numbers are amenable to immunisation before discharge (Riley et al, 1991; Bell et al, 1997; Conway, 1999; Henderson et al, 2004; Gandhi et al, 2011). Appointing a dedicated immunisation coordinator side-steps many of these issues and led to an 83% pre-discharge immunisation rate in one centre (Shingler et al, 2012). We agree with Gilbert and Wrigley (2009) that lack of confidence and standardised training for doctors and nurses represents a genuine issue that future studies could address.

Conclusion and recommendations

This study has demonstrated that instituting a handful of simple measures can improve positive identification of children who are eligible for immunisation; however these measures do not in themselves increase rates of opportunistic inpatient immunisation. Reassessing immunisation status in another five months may demonstrate higher catch-up rates in those children whose GPs received discharge letters, and future work should incorporate a longer follow-up period. In children assessed in the acute secondary care setting rates of under-immunisation were three times higher than community rates. These children represent a vulnerable group with a sizeable susceptibility burden to the full range of vaccine-preventable diseases. We feel that our findings are broadly generalizable to a number of clinical settings. We recommend that other centres employ our measures to identify under-immunised patients and suggest that further studies assess the role of immunisation coordinators and staff training in translating this information into opportunistic immunisation. Trusts, local authorities and central government all have responsibility for improving immunisation coverage and frank discussion is important in determining who will foot the bill for the additional services required to improve practice in this area.

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Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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Ethics approval

Approval was granted by the Royal Cornwall Hospital clinical audit department

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