Acute upper respiratory infections in Western Australian emergency departments, 2000–2003

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Abstract

Objective: To describe the epidemiological and other characteristics of emergency department (ED) presentations diagnosed with acute upper respiratory infection (URI).

Design and setting: A retrospective study of patients given an ED diagnosis of acute URI from July 2000 to July 2003 at any of the four metropolitan teaching hospitals in Perth, Western Australia.

Results: Acute URI accounted for 3.6% (95% CI, 3.5–3.7) of ED presentations, and 80.7% (95% CI, 80.1–81.3) of these were aged less than 15 years. The most common diagnosis was acute upper respiratory infections of multiple and unspecified sites, followed by croup and acute tonsillitis. Of those with croup, 76.0% (95% CI, 74.7–77.3) presented at night, 67.6% (95% CI, 66.2–69.0) were male and the number of presentations with croup was highest in June 2002. The number of diagnoses of acute tonsillitis did not display a great deal of variation from month to month. Overall, hospital admission was 12.3% (95% CI, 11.8–12.8), with a median length of hospital stay of 1 day (IQR 1.0–2.0). An increase in comorbidity, residing in the most disadvantaged areas, and being a re-presentation increased the odds of being admitted.

Conclusion: Further investigation is needed into whether alternative medical care services would be appropriate and acceptable for patients with less severe acute URIs.

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What is known about the topic?
Upper respiratory infection (URI) is a frequent problem managed in Australian general practice, and in the hospital setting, children and young adults account for most of the hospital separations for this condition. There are few published data relating to the frequency and other characteristics of acute URI presentations to hospital emergency departments.

What does this paper add?
This study provides data on presentations (admitted and non-admitted) diagnosed with acute URI in hospital emergency departments. Those presenting were predominantly children, with very few requiring inpatient admission.

What are the implications for practitioners?
This study provides baseline data which could be used when assessing changes in health service delivery. Further investigation is needed into why patients with less severe illnesses present to emergency departments and which, if any, alternative medical care services would be appropriate and acceptable for these patients.

UPPER RESPIRATORY INFECTION (URI) is the second most frequent problem managed in Australian general practice, accounting for around 5.6 per 100 general practice encounters.[1] In the hospital setting, children and young adults account for most of the hospital separations for acute URI

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including the specific discharge diagnoses obstructive laryngitis (croup) and tonsillitis.[2] However, there is a paucity of data relating to the frequency of presentation to hospital emergency departments (EDs) and subsequent re-presentation for these conditions. The aim of the present study was to use ED data linked to hospital morbidity, death and microbiology data to describe the epidemiological and other characteristics of ED presentations diagnosed with acute URI.

Methods

Study design and data source

We conducted a retrospective study of all patients given an ED diagnosis of acute URI from July 2000 to July 2003 at any of the four metropolitan teaching hospitals in Perth, Western Australia. Collectively, these hospitals serve a population of around 1.5 million people.

ED, hospital morbidity and mortality records were patient linked by the Western Australian Data Linkage Unit using probabilistic matching.[3-5] The data linkage process allows records from individual contributing datasets to be identified as belonging to the same patient.

The ED and morbidity records relating to the same episode of care were then matched by comparing ED arrival and discharge times to hospital admission times. Bacterial culture results were matched to the ED records on the basis of hospital, medical record number and dates of specimen collection, ED arrival, ED discharge and hospital separation. Virology and microscopy data were not available for linkage.

The cohort was selected based on the International Classification of Diseases codes for acute URI, and included Tenth Revision Australian Modification (ICD-10-AM) codes J00 to J06 and the equivalent Ninth Revision (ICD-9) codes 460 to 465. A change in use of revision occurred in one hospital during the study period, hence the need to use both volumes.

Ethics

Ethics approval for the study was received from the Western Australian Confidentiality of Health Information Committee and the Human Research Ethics Committees of The University of Western Australia and of each of the study hospitals.

Data analysis

Descriptive statistical analyses were performed using the SPSS software version 12 (SPSS Inc, Chicago, Ill, USA) and logistic regression performed using Intercooled STATA 8 (StataCorp LP, College Station, Tex, USA).

Frequencies, proportions, and medians with interquartile ranges (IQR) of data contained in the variables were calculated. These included: sex; age (children defined as age less than 15 years); night presentation (defined as presenting between 6pm and 6am the following morning); month and year of presentation; admission; length of hospital stay (LOS); re-presentation; death; blood culture, throat swab culture and bacteria isolated. P values with the statistical significance set at $a = 0.05$ and 95% confidence intervals (CIs) were reported where appropriate.

Logistic regression with a robust standard error to accommodate possible correlation of attendances of the same patient was performed to determine predictors of admission. As a robust standard error was not available in SPSS, STATA 8 was used for this part of the analysis. Univariate analysis was performed on all variables of interest. All variables significant at the $P = 0.1$ level were then placed in the logistic model as one block of variables and multivariate analysis performed. The model was refitted with only variables significant at the $P = 0.05$ level. To help interpret the meaning of any significant interaction between a categorical and quantitative variable, the predicted probability of admission was calculated for each categorical level. Adjusted odds ratios with 95% CIs were reported.

The difference in the proportion of males versus females with croup was reported as rate ratios. In this case, the Perth metropolitan male and female populations as recorded in the 2001 population census[6] were used as rate denominators.

Definitions

The ED triage score,[7] which ranges from 1 (most urgent) to 5 (least urgent), although correctly meaning urgency, was used as a surrogate measure of severity.

The Index of Relative Socio-Economic Advantage/Disadvantage[8] was used as an indicator of socioeconomic status and classified each ED presentation into one of five socioeconomic groups based on the postcode of their residence. A higher score on this index indicates that the patient resided in an area which had a relatively high proportion of people with high incomes or work skills.[8]

Re-presentations

For each patient, their first recorded ED diagnosis of an acute URI was considered as their first index presentation for that infection type. If a patient presented with another acute URI at least 28 days after leaving hospital this was classified as a further index presentation. Presentations diagnosed with an acute URI within 7 days of an index presentation were assumed to be due to the same infection and thus classified as re-presentations. As an additional analysis, the proportion of index presentations that subsequently returned to the ED within 7 days for any reason was calculated.

Comorbidities

The comorbidity measure used in logistic regression was based on the Charlson Index.[9] This index is determined from 17 clinical conditions shown to be associated with mortality and weighted according to severity. Mapping of the conditions to groups of ICD 10 codes was developed by the School of Population Health, The University of Western Australia, using the Dartmouth–Manitoba algorithm for administrative data.[10] The relevant ICD 10 codes were extracted from the 21 diagnosis fields of the morbidity record of the most recent admission within 12 months preceeding each ED diagnosis of an acute URI. The comorbidity measure for the cohort ranged from 0 to 9 with 0 meaning no relevant comorbidities recorded or no admission within the time period.

Bacteriology

To avoid including possible hospital-acquired infection, only blood or throat swabs taken within 2 days of ED arrival were included in the analysis for admitted patients. *Staphylococcus epidermidis*, non-specified coagulase negative staphylococci and other organisms commonly originating from normal skin flora or the environment were considered probable contaminants of blood cultures.

Results

There were 520 524 ED presentations during 2000–2003 and 96.1% of these had an ED diagnosis code recorded. Acute URI accounted for 3.6% (17 969/500 168; 95% CI, 3.5–3.7) of the diagnoses. Of these, 2.5% (445) were triaged at categories 1 or 2 (most urgent), 19.8% (3565) at category 3 and 77.6% (13 956) at categories 4 or 5 (least urgent). One patient died in the ED and a further three patients died in hospital after admission. Children accounted for most of the diagnoses with 80.7% (14 495/17 969; 95% CI, 80.1–81.3) aged less than 15 years. Overall, the median age was 3.3 years (IQR, 1.4–9.4). Further, acute URIs accounted for 10.6% (14 497/136 293; 95% CI, 10.4–10.8) of all paediatric presentations at the study hospitals.

Diagnoses

The breakdown of the specific diagnoses according to age group is shown in Box 1. The most common ED diagnosis overall was acute upper respiratory infections of multiple and unspecified sites (ICD 10 code J06). The most common specific diagnoses were acute tonsillitis (J03) and croup (J05). Epiglottitis was diagnosed in 21 patients, of whom seven were younger than 15 years.

Sex

Males accounted for 56.6% (10 168/17 969; 95% CI, 55.9–57.3) of the presentations. A notable sex difference was seen with the diagnosis of croup. Males accounted for 67.6% (2813/4159; 95% CI, 66.2–69.0) of patients younger than 15 years with this diagnosis. This difference remained evident after considering the relative male and female paediatric populations of Perth at the time

1 Number of emergency department (ED) presentations with acute upper respiratory infection (URI) at the study hospitals, 2000 to 2003, according to age, and proportion admitted

	ED diagnosis							
	Acute nasopharyngitis	Acute sinusitis	Acute pharyngitis	Acute tonsillitis	Acute laryngitis and tracheitis	Acute obstructive laryngitis (croup) and epiglottitis	Acute upper respiratory infections of multiple and unspecified sites	Total acute URI diagnoses (%)
ICD 10 code	J00	J01	J02	J03	J04	J05	J06	
Age (years)								
< 1	18	0	38	209	2	594	2189	3050 (17.0%)
1–4	5	2	145	1637	6	2747	3606	8148 (45.3%)
5–14	7	29	174	961	30	825	1271	3297 (18.3%)
15–24	2	20	182	747	13	5	409	1378 (7.7%)
25–34	3	27	128	377	9	0	287	831 (4.6%)
35–44	4	19	91	136	10	8	189	457 (2.5%)
45–54	5	15	66	38	4	1	192	321 (1.8%)
55–64	5	10	41	21	5	1	111	194 (1.1%)
65–74	1	3	21	5	7	2	99	138 (0.8%)
75–84	0	3	14	0	4	2	84	107 (0.6%)
> 85	0	0	5	3	1	0	39	48 (0.3%)
Total	50	128	905	4134	91	4185	8476	17 969
Proportion admitted	2.0%	18.0%	11.7%	18.8%	35.2%	18.5%	5.9%	12.3%

of the study (rate ratio for croup in children, male to female, 2 : 1). Further, 19.1% (537/2813; 95% CI, 17.6–20.6) of males diagnosed with croup were admitted to hospital, compared with 16.7% (220/1346; 95% CI, 14.3–18.3) of females.

Temporal pattern

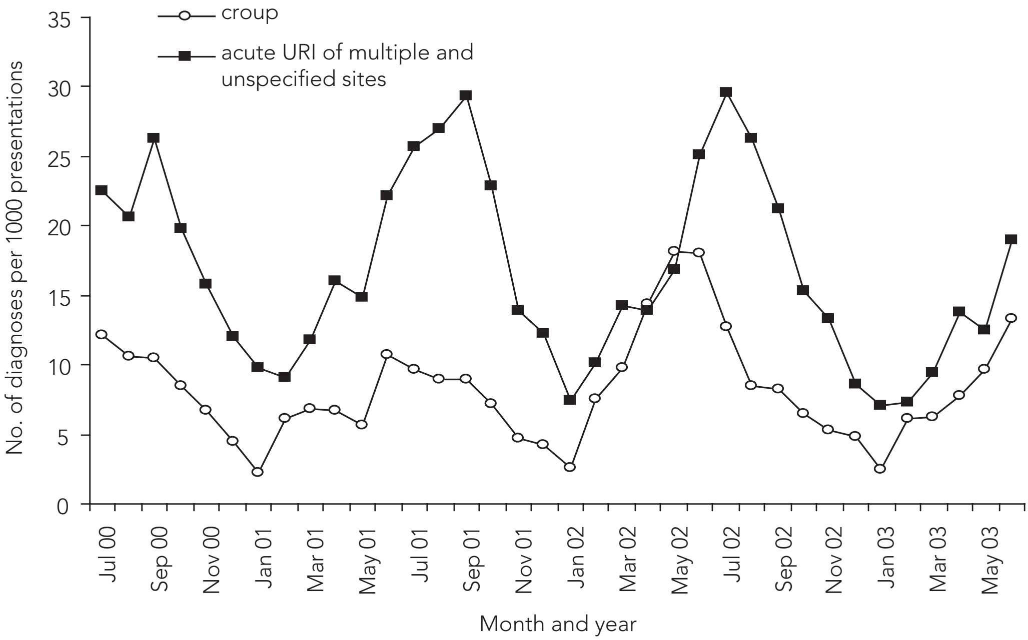
Collectively, the number of presentations diagnosed with acute URI was highest in July 2002 (all ages, crude rate 54.7 diagnoses per 1000 ED presentations). The number of croup diagnoses dropped in January and was highest in June 2002 (Box 2) (all ages, crude rate 18.1 diagnoses per 1000 ED presentations, age specific rate 87 diagnoses per 1000 ED presentations for patients 1–4 years of age). Acute pharyngitis and acute tonsillitis, however, did not display a great deal of variation from month to month (Box 3).

Of those diagnosed with croup, 76.0% (3165/4185; 95% CI, 74.7–77.3) presented at night. In contrast, a significantly smaller proportion of those diagnosed with acute sinusitis (J01), acute pharyngitis (J02) or acute tonsillitis (J03) presented at night (41.4%, $P < 0.001$; 46.5%, $P < 0.001$; 49.3%, $P < 0.001$, respectively).

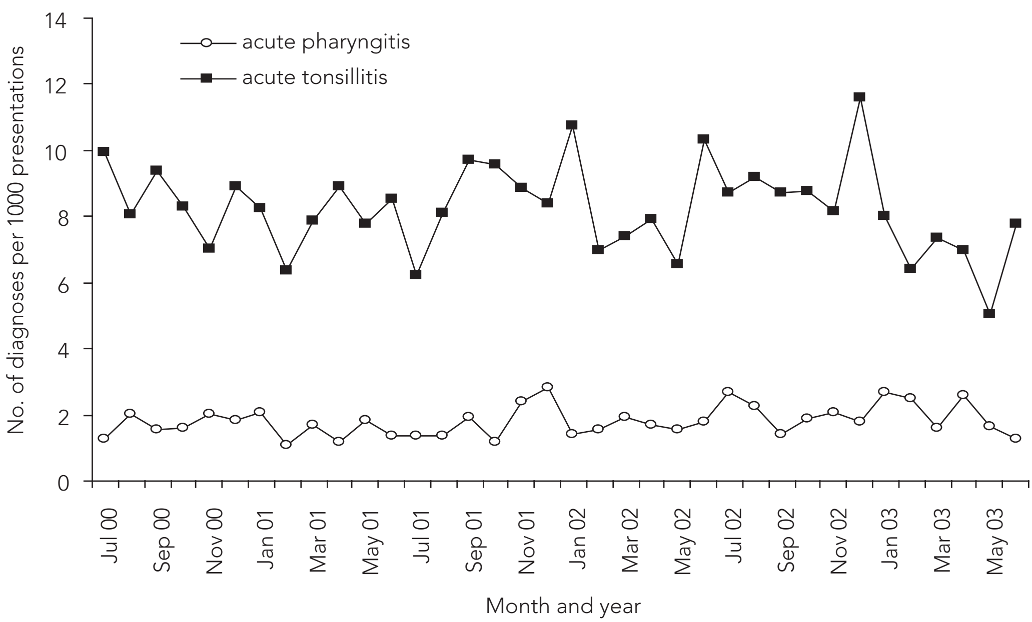
Admission

Overall, admission was 12.3% (2215/17 969; 95% CI, 11.8–12.8) with a median length of hospital stay of 1.0 day (IQR, 1.0–2.0). Of the 2215 admitted patients, 874 (39.5%) had a hospital stay of greater than 1 day and the cumulative

2 Number of diagnoses of croup and acute upper respiratory infection (URI) of multiple and unspecified sites per 1000 ED presentations according to month and year of study



3 Number of diagnoses of acute pharyngitis and acute tonsillitis per 1000 ED presentations according to month and year of study



LOS was 4687 days. Admission varied according to diagnosis, with 35.2% (32/91) of patients with acute laryngitis or tracheitis, and 18.8% (776/4134) with acute tonsillitis admitted (Box 1). Of the latter, 4.5% (35/776) underwent tonsillectomy or incision and drainage of peritonsillar abscess.

An increase in comorbidity, residing in the most disadvantaged areas and having previously presented within 7 days with an acute URI were associated with an increase in the odds of being admitted (Box 4). Further, age modified the effect of triage score on admission. For triage score 4 (less urgent) the probability of admission increased with age. However, with triage score 2, suggesting a greater urgency, the predicted probability of admission decreased as age increased.

For those given an ED diagnosis of acute upper respiratory infections of multiple and unspecified sites (J06) and admitted to hospital, 30.6% (154/503) separated from hospital with the same diagnosis, 8.3% (42/503) with viral infection of unspecified site, 8.3% (42/503) with bronchiolitis and 6.6% (33/503) with unspecified acute lower respiratory tract infection. Other specific principal discharge diagnoses accounted for less than 3.5% of admissions with a provisional diagnosis of J06.

4 Predictors of admission for patients with an emergency department diagnosis of acute upper respiratory infection

Variable	Odds ratio	95% CI	*P* value
Comorbidity	1.17	1.04–1.31	0.010
Socioeconomic group 5 (reference most advantaged)			
Socioeconomic group 4	1.22	1.05–1.42	0.012
Socioeconomic group 3	1.05	0.91–1.22	0.489
Socioeconomic group 2	1.50	1.28–1.76	< 0.001
Socioeconomic group 1 (least advantaged)	1.62	1.35–1.94	< 0.001
Last presentation for any reason (reference 0 presentations or > 28 days)			
Last presentation 2 (≤ 3 days)	1.62	1.29–2.04	< 0.001
Last presentation 3 (4–7 days)	1.34	0.94–1.92	0.110
Last presentation 4 (8–14 days)	1.19	0.85–1.68	0.311
Last presentation 5 (15–28 days)	1.08	0.81–1.45	0.583
7-day re-presentation	1.84	1.36–2.50	< 0.001
Age	0.96	0.95–0.97	< 0.001
Triage	0.26	0.24–0.29	< 0.001
Interaction age by triage			<0.001

Re-presentation

Of the index presentations, 8.7% (1487/17 153; 95% CI, 8.3–9.1) returned to the ED within 7 days and 3.3% (566/17 153; 95% CI, 3.0–3.6) re-presented and were again diagnosed with an acute URI. Other diagnoses on re-attendance varied, but viral infection of unspecified site (ICD 10 code B34) was the most common (18.0%, 166/921). Patients younger than 15 years were more likely to return within 7 days compared with those who were older (9% [1243/13 789] v 7.3% [244/3364]; $P = 0.001$).

Bacteriology

Blood was collected and cultured from 4.1% (741/17 969; 95% CI, 3.8–4.4) of patients (1.4%, [243/15 753] non-admissions; 22.4% [497/2215] admissions; $P < 0.001$, 1/1 who died in the ED) although this varied across specific diagnoses and included 17.6% (16/91) for acute laryngitis/tracheitis, 9.2% (380/4134) for acute tonsillitis, 4.9% (44/905) for acute pharyngitis and 0.9% (36/4185) for croup. Overall, 2.3% (17/741; 95% CI, 1.2–3.4) of blood cultures grew potential pathogens and *Streptococcus* spp. accounted for 10 of the 17 positive cultures.

Throat swab specimens were cultured from 2.7% (422/15 753; 95% CI, 2.4–3.0) of non-admitted patients and 22.7% (96/422; 95% CI, 18.7–26.7) of cultures were positive. In contrast, 12.0% (265/2215; 95% CI, 10.6–13.4) of admissions had throat swab specimens cultured, with 18.1% (48/265; 95% CI, 13.5–22.7) positive. Overall, *Streptococcus pyogenes* accounted for

78.5% (113/144) of positive cultures, 9.7% (14/144) grew *Streptococcus* Group G, and 5.6% (8/144) grew *Streptococcus* Group C

Discussion

Children accounted for most presentations diagnosed with acute URI. In particular, the 1–4 year olds contributed to around 45% of diagnoses, frequently with croup. This reflects the Australia-wide hospital separation data that reports around 40% of separations with acute URI are children of this age.[2]

Nearly half of the URI diagnoses were recorded as acute URI of multiple and unspecified sites with an admission rate of less than 6%. This low rate of admission suggests that the majority of these patients do not require inpatient management of their illness, but are presenting to EDs for other reasons. These may include: perception of severity, urgency or complexity of illness; perception of more effective care available in an ED; being able to obtain assessment, investigations and treatment in a single visit; or lack of access to general practitioners or other suitable alternatives.[11] For example, those diagnosed with croup tended to present at night when symptoms typically worsen and the hospital may have been the only medical assistance readily available.

Males accounted for around twice the number of ED croup diagnoses as females, with a slightly higher proportion of these males requiring hospital admission compared with females. Male predominance in croup presentations and admissions is also evident in overseas studies[12,13] and Australia-wide hospital separation statistics.[2] As we determined crude rates based on Perth's population, it appears that males have a higher rate of croup and/or more severe croup than females. Another possibility is that male children are more often brought to medical care than females, for reasons other than severity of illness. This would be interesting to explore further.

Reasons for the sex differences in susceptibility to respiratory infections are unknown. However, there are sex differences in the diagnosis of asthma, where males are dominant in childhood but the ratio is reversed after puberty.[14] One line of thought on these differences in asthma relates to sex differences in lung development and function and differences in immune response.[14] Perhaps a similar explanation may apply to croup.

The yearly trends for respiratory infections such as croup are congruent with notifications of some of the potential agents of respiratory infections, including the ortho/paramyxoviruses, to the Laboratory Virology and Serology Reporting Scheme (LabVISE). In particular, more than double the number of the influenza viruses were reported to LabVISE in 2002 compared with 2001, but there were also increased numbers of parainfluenza type 1 and 2 and respiratory syncytial virus.[15] These agents are commonly found in those with croup.[12,16-18] It is reassuring that only a very small proportion of those diagnosed with croup had blood cultured, given the likely viral aetiology of this illness.

Similar to results from previous work,[19] the present study showed that those less advantaged were more likely to be admitted to hospital and those with increased comorbidity were also more likely to be admitted. While the proportion of re-presentations was relatively low, the smaller the time period since the last ED attendance, the greater the likelihood of being admitted. This may reflect treatment failure, being discharged too early, complications, or unrealistic patient expectations of the natural course of the illness.

Age modified the effect of triage on admission. This is not easy to interpret. For those triaged as high urgency, the probability of admission decreased as age increased. This may be due to the vulnerability of the very young child and hence their admission to enable further observation. However, in contrast, for those considered as needing less urgent care, the probability of admission increased with age. In this case, the result may be related to the specific diagnosis of the patient or to comorbid conditions exacerbated by the acute illness. For example, tonsillitis may be triaged as category 4, but perhaps adults rather than children are more likely to be admitted to undergo surgery or other procedures. Alternatively, older patients may have conditions such as diabetes or renal impairment and decompensate due to the acute illness, requiring hospitalisation. Further investigation of this issue would be useful.

The study was limited by the variables recorded in the datasets. Further, re-presentation may have been underestimated as patients may have re-presented to hospitals not included in the study, or to their general practitioner. However, the inclusion of both non-admitted and admitted patients gave the study its uniqueness and strength. Further, large, linked datasets were used and incorporated details relating to more than one site and to presentations of all ages. Results of this near population-based study most likely reflect the situation in other cities with similar health systems.

In conclusion, children contributed to most of the presentations with acute URI, but the triage scores, admission rate and LOS suggest that many URIs were not severe. Further investigation is needed into why patients with less severe illnesses present to EDs and which alternative medical care services would be appropriate and acceptable for these patients.

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Competing interests

The authors declare that they have no competing interests.

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