Neonatal presentations to the paediatric emergency department in Singapore

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Abstract

Introduction: This study aimed to characterise neonatal paediatric emergency department (PED) visits, analyse the main paediatric illnesses and establish associations of these demographics with the readmission rates and severity of their presentation.

Methods: A retrospective analysis of neonates (aged <28 days) presenting to the PEDs of our hospital over seven months was performed. Associations between the clinical and demographic data of admissions to the PED and inpatient admissions were analysed.

Results: In total, 1,200 neonates presented during the study period, 79.4% of whom presented at less than 15 days since birth. Length of stay in the PED was less than four hours for 94.0% of the neonates. Predominant triage categories comprised non-P1 cases (97.5%). The main diagnoses at the PED were neonatal jaundice (NNJ; 66.8%) and neonatal pyrexia (NNP; 14.6%), which corresponded to the main diagnoses upon discharge from the hospital: NNJ (68.4%) and NNP (19.6%). 48.2% of neonates were referred from polyclinics or other clinics. 57.7% of the neonates were admitted. Interestingly, 87.0% of the well babies who presented to the emergency department were brought in owing to parental concerns by the parents themselves, without prior consultation with the doctor.

Conclusion: Outpatient management of NNJ can be considered. Caregivers should be provided better education regarding normal physiological characteristics of newborns through standardised educational materials. Other potential avenues for parents to seek medical advice, for example hotlines and ChatBots such as the recently piloted ‘Urgent Paediatric Advice Line’ online service, should be considered.

Keywords: Emergency, neonates, newborn, paediatric, presentations

INTRODUCTION

Increased attendance of neonates to the paediatric emergency department (PED) has been observed over the past few decades worldwide.1-3 This trend appears to be in line with the shifting paradigm towards earlier discharge of the neonatal population in the postpartum period.1-4-6

Shorter neonatal hospital stays might be a part of efforts to more efficiently allocate healthcare resources and cut costs arising from unnecessarily prolonged hospitalisations.7 Early postnatal discharge could also improve maternal-infant bonding and paternal involvement.8 However, the neonatal population is a group that is highly susceptible to infections, and their increased attendance and consequent exposure to the infectious environment of the PED raises concerns.

Many studies have been conducted to ascertain the benefits and risks9-12 of this trend of earlier discharges, with many of these studies using readmission rates as an indicator of morbidity.9,13,14 Several studies have demonstrated a correlation of shorter postpartum hospital stay with increased neonatal readmission rates.15-17 However, reviews of these studies have also concluded that methodological flaws and insufficient sample sizes might make it difficult to accurately

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conclude the consequences of shorter neonatal hospital stays.[18,19]

The PED provides not only acute care for sick newborn infants but also a significant amount of primary care, reassurance and parental education.[6] Several studies have pointed out physiological characteristics of the neonates and parents’ doubts as the main reasons for neonatal presentations to the PED.[1,6,20] With the trend towards earlier neonatal discharge, there has been a shift in focus of early infant care from the tertiary to the outpatient setting in the form of family physician follow-up, in-house nursing support and PED care.[9,21-23] Measures to provide a coordinated care programme with early discharge have been shown to reduce the use of PED in infancy, indicating that some PED visits are potentially preventable.[24]

This study, performed in the largest tertiary paediatric centre in Singapore, aimed to characterise neonatal PED visits, analyse the main illnesses and establish associations of these demographics with the readmission rates and severity of their presentation.

METHODS

A retrospective review of neonatal (≤28 days of life) presentations to the emergency department (PED) of KK Women’s and Children’s Hospital (KKH), Singapore, from September 2016 to March 2017 was conducted. Data was collected from the electronic database (Citrix) of neonatal factors and emergency data of neonatal presentation based on the PED visit documentation.

Neonatal factors included gestational age, gender, race, birth weight, Apgar score, labour type and time of discharge after birth. Emergency data of neonatal presentation included age at presentation, triage category, re-attendance, length of stay in the PED, method of referral, presenting complaint, diagnosis, disposition and highest level of care (for admitted neonates) and the final diagnosis.

Data was entered in a Microsoft Excel spreadsheet (version 2016). IBM SPSS Statistics version 22.0 for Windows (IBM Corp, Armonk, NY, USA) was used to generate descriptive data for reporting. Values were reported as mean ± standard deviation or median with interquartile range for continuous variables (depending on normality) and as percentages for categorical variables. Continuous variables were analysed using t-test (or its non-parametric equivalent) and dichotomous variables were analysed using Chi-square test or Fisher’s exact test, as appropriate.

RESULTS

The demographic profile of the neonates as well as their emergency visit and admission demographics in the PED are described as follows.

A total of 1,200 neonates (age <28 days) presented to the PED during the study period. 51.7% of these were male and 48.3% were female [Table 1]. 53.7% of the neonates belonged to Chinese race, 26.4% to Malay race, 10.4% to Indian race and 9.5% to other races. 87.2% of the neonates were born at term and 8.8% were born preterm [Table 1]. The birth weight of 90.8% of neonates was more than 2,500 grams; 7.3% of them had a low birth weight. 61.3% of neonates were born by normal vaginal delivery, 13.4% by elective lower segment caesarean section (LSCS), 12.8% by emergency LSCS, 8.0% by vacuum delivery and 1.6% by forceps-assisted delivery. Among the neonates who presented to the PED, 89.8% and 90.7% of the neonates had one-minute and five-minute Apgar scores ≥7, respectively, while 1.0% and 0.1% of the neonates had a one-minute and five-minute Apgar score <7.

| Table 1. Demographics of neonates presenting to the PED. |
|---------------------------------|
| **Demographic variable** | **No. (%)** |
|---------------------------------|
| **Gestation (wk)** | | |
| <37 | 106 (8.8) |
| ≥37 | 1,046 (87.2) |
| Unknown | 48 (4.0) |
| **Gender** | | |
| Male | 620 (51.7) |
| Female | 580 (48.3) |
| **Apgar score (1 min)** | | |
| <7 | 12 (1.0) |
| ≥7 | 1,077 (88.9) |
| Unknown | 111 (9.3) |
| **Apgar score (5 min)** | | |
| <7 | 1 (0.1) |
| ≥7 | 1,088 (90.7) |
| Unknown | 111 (9.3) |
| **No. of days of life at discharge from birth (discharge from the first hospitalisation for the birth of the child)** | | |
| <4 | 782 (65.2) |
| ≥4 | 80 (6.7) |
| Unknown | 338 (28.2) |
| **Age at presentation (days of life)** | | |
| <15 | 953 (79.4) |
| ≥15 | 247 (20.6) |
| **Re-attendance within 72 hr of first presentation to the PED** | | |
| Yes | 78 (6.5) |
| No | 1,122 (93.5) |
| **Triage category** | | |
| P1 | 30 (2.5) |
| Non-P1 | 1,170 (97.5) |
| **Length of stay in PED (hr)** | | |
| <4 | 1,128 (94.0) |
| ≥4 | 72 (6.0) |
| **Method of referral** | | |
| Self | 608 (50.7) |
| Polyclinic | 351 (29.3) |
| Others | 227 (18.9) |
| Unknown | 14 (1.2) |

PED: paediatric emergency department
Neonates with neonatal jaundice (NNJ) were referred by the polyclinics and other clinics [Table 1]. 65.1% of the parents brought their neonates in by themselves, whereas 48.2% were referred by the doctor [Table 1]. The majority (50.7%) of the patients were brought in by the parents themselves, whereas 48.2% were referred by the polyclinics and other clinics [Table 1]. 65.1% of the neonates with neonatal jaundice (NNJ) were referred by the polyclinics or other clinics. Importantly, 87.0% of the well babies (diagnosed at the end of the PED consultation) who attended the PED were brought in owing to parental concerns by the parents themselves, without a prior consultation with the doctor [Table 2]. Of these 69 well babies, 9 (13.0%) were eventually admitted likely owing to parental concerns and also from the lack of confidence in first-time parents. Of these nine babies, none were re-attendances and all were of general ward status. None of them went to the high-dependency unit or ICU.

NNJ accounted for the largest proportion (66.8%) of cases seen in the PED. However, it is important to contextualise this information, as these patients were usually sent for admission from the polyclinics during the weekdays or for checking serum bilirubin during the weekends, given that polyclinics are closed on the weekends. After excluding NNJ, neonatal pyrexia (NNP; 14.6%) was the most common diagnosis at the end of the PED consultation [Table 1]. Out of the 78 (6.5%) neonates that re-attended, all had a general ward status and none were admitted to the high-dependency or intensive care unit (ICU); one had sepsis, and none had meningitis or hypoglycaemia. The length of stay in the emergency department was <4 hours for 94.0% of neonates, while 6.0% of these stayed in the emergency department for ≥4 hours.

The majority (50.7%) of the patients were brought in by the parents themselves, whereas 48.2% were referred by the polyclinics and other clinics [Table 1]. 65.1% of the neonates with neonatal jaundice (NNJ) were referred by the polyclinics or other clinics. Importantly, 87.0% of the well babies (diagnosed at the end of the PED consultation) who attended the PED were brought in owing to parental concerns by the parents themselves, without a prior consultation with the doctor [Table 2]. Of these 69 well babies, 9 (13.0%) were eventually admitted likely owing to parental concerns and also from the lack of confidence in first-time parents. Of these nine babies, none were re-attendances and all were of general ward status. None of them went to the high-dependency unit or ICU.

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### Table 2. Diagnoses of neonates discharged from the PED.

| Diagnosis                      | No. of patients discharged | Total discharged patients % | Total discharge diagnosis | % | No. of re-attendance | Specific discharge diagnosis | % | Total discharge diagnosis | % | No. of self-referred patients | Specific discharge diagnosis | % | Total discharge diagnosis | % |
|-------------------------------|----------------------------|-----------------------------|---------------------------|---|----------------------|----------------------------|---|---------------------------|---|---------------------------|----------------------------|---|---------------------------|---|
| Neonatal jaundice             | 343                        | 67.7                        | 65.3                      | 23 | 6.7                  | 88.5                      | 123 | 35.9                      | 43.6 |                        |                             |   |                         |    |
| Well baby                     | 60                         | 11.8                        | 11.4                      | 0  | 0                    | 0                         | 52  | 86.7                      | 18.4 |                        |                             |   |                         |    |
| Others                        | 45                         | 8.9                         | 8.6                       | 3  | 6.7                  | 11.5                      | 39  | 86.7                      | 13.8 |                        |                             |   |                         |    |
| Viral URTI                    | 39                         | 7.7                         | 7.4                       | 0  | 0                    | 0                         | 37  | 94.9                      | 13.1 |                        |                             |   |                         |    |
| Colic                         | 12                         | 2.4                         | 2.3                       | 0  | 0                    | 0                         | 12  | 100.0                     | 4.3  |                        |                             |   |                         |    |
| Conjunctivitis                | 8                          | 1.6                         | 1.5                       | 0  | 0                    | 0                         | 6   | 75.0                      | 2.1  |                        |                             |   |                         |    |
| Neonatal pyrexia              | 6                          | 1.2                         | 1.1                       | 0  | 0                    | 0                         | 3   | 50.0                      | 1.1  |                        |                             |   |                         |    |
| Ophthalmia neutororurn        | 4                          | 0.8                         | 0.8                       | 0  | 0                    | 0                         | 2   | 50.0                      | 0.7  |                        |                             |   |                         |    |
| Erythema toxicum              | 3                          | 0.6                         | 0.6                       | 0  | 0                    | 0                         | 3   | 100.0                     | 1.1  |                        |                             |   |                         |    |
| GERD                          | 2                          | 0.4                         | 0.4                       | 0  | 0                    | 0                         | 2   | 100.0                     | 0.7  |                        |                             |   |                         |    |
| Viral gastroenteritis         | 2                          | 0.4                         | 0.4                       | 0  | 0                    | 0                         | 2   | 100.0                     | 0.7  |                        |                             |   |                         |    |
| LRTI                          | 1                          | 0.2                         | 0.2                       | 0  | 0                    | 0                         | 1   | 100.0                     | 0.4  |                        |                             |   |                         |    |
| Sepsis                        | 0                          | 0                           | 0                         | 0  | 0                    | 0                         | 0   | 0                         | 0    |                        |                             |   |                         |    |
| Apparent life-threatening event| 0                          | 0                           | 0                         | 0  | 0                    | 0                         | 0   | 0                         | 0    |                        |                             |   |                         |    |
| Hypoglycaemia                 | 0                          | 0                           | 0                         | 0  | 0                    | 0                         | 0   | 0                         | 0    |                        |                             |   |                         |    |
| Urinary tract infection       | 0                          | 0                           | 0                         | 0  | 0                    | 0                         | 0   | 0                         | 0    |                        |                             |   |                         |    |
| Meningitis                    | 0                          | 0                           | 0                         | 0  | 0                    | 0                         | 0   | 0                         | 0    |                        |                             |   |                         |    |
| Total no. of diagnoses        | 525                        | 100.0                       | 26                        | 100.0                     | 282 | 53.7                     | 100.0 |                        |                             |   |                         |    |
| Total no. of discharged patients | 507                        |                             |                           |                             |                       |                         |     |                         |                             |   |                         |    |

Out of 1,200 patients, 507 were discharged with a total of 525 discharge diagnoses due to some overlapping diagnoses. ‘% of total discharged patients’ uses 507 (no. of discharged patients) as the denominator. ‘% of total discharge diagnosis’ uses 525 (no. of total discharge diagnosis) as the denominator. ‘% of specific discharge diagnosis’ uses the no. of patients discharged for that specific diagnosis as the denominator. GERD: gastroesophageal reflux disease, LRTI: lower respiratory tract infection, PED: paediatric emergency department, URTI: upper respiratory tract infection.
Developmental dysplasia of the hip, neck torticollis and bilateral congenital talipes equino varus were the musculoskeletal concerns for which the parents brought their babies to the PED. The predominantly observed dermatological conditions were neonatal acne, eczema, erythema toxicum and fungal diaper rash. Surgical conditions such as ileal atresia, pyloric stenosis, imperforate anus, malrotation with volvulus and abdominal distention secondary to Hirschsprung disease were observed in 9.0% of the neonates. Hypoglycaemia and congenital adrenal hyperplasia were the predominant endocrinological disorders.

Of the 802 patients with NNJ, 73 patients had concurrent NNP, three patients had concurrent viral upper respiratory tract infections, three patients had concurrent gastroesophageal reflux disease, two patients had concurrent hypoglycaemia and two patients had concurrent conjunctivitis. Sepsis, colic, ophthalmia neonatorum and erythema toxicum were concurrently diagnosed in four patients with NNJ.

Out of the 1,200 neonates who attended the emergency department during the study period, 693 (57.7%) were admitted for inpatient care. In terms of their disposition, 98.6% of these neonates went to the general ward, 1.2% to the high-dependency unit and 0.3% to the ICU. Out of the 693 neonates admitted, 668 (96.4%) were under the non-P1 category, with the most frequent being NNJ, (56.2% of non-P1 admissions), followed by NNP (20.7%).

Among the patients with NNJ, 459 (57.2%) patients were admitted, 169 (21.0%) were treated and discharged.

### Table 3. Diagnoses of neonates presenting to the PED.

| Diagnosis                        | At the end of PED consultation | Final diagnosis after admission |
|----------------------------------|--------------------------------|--------------------------------|
| Neonatal jaundice                | 802 (66.8)                     | 474 (68.4)                     |
| Neonatal pyrexia                 | 175 (14.6)                     | 136 (19.6)                     |
| Others                           | 127 (10.6)                     | 63 (9.1)                       |
| Well baby                        | 69 (5.8)                       | 28 (4.0)                       |
| Viral upper respiratory tract infection | 64 (5.3)                     | 38 (5.5)                       |
| Gastroesophageal reflux disease  | 17 (0.4)                       | 38 (5.5)                       |
| Conjunctivitis                   | 14 (1.2)                       | 11 (1.6)                       |
| Viral gastroenteritis            | 13 (1.1)                       | 11 (1.6)                       |
| Colic                            | 13 (1.1)                       | 0 (0)                          |
| Apparent life-threatening event  | 11 (0.9)                       | 7 (1.0)                        |
| Lower respiratory tract infection| 9 (0.8)                        | 10 (1.4)                       |
| Sepsis                           | 8 (0.1)                        | 15 (2.2)                       |
| Ophthalmia neonatorum            | 7 (0.6)                        | 4 (0.6)                        |
| Erythema toxicum                 | 7 (0.6)                        | 4 (0.6)                        |
| Hypoglycaemia                    | 3 (0.3)                        | 1 (0.1)                        |
| Urinary tract infection          | 1 (0.1)                        | 12 (1.7)                       |
| Meningitis                       | 0 (0)                          | 10 (1.4)                       |
| Total number of PED diagnoses    | 1,340                          | 862                            |

PED: paediatric emergency department

### Table 4. Characteristics of admitted and non-admitted neonates.

| Parameters                        | Admitted Mean±SD (IQR) | Not admitted Mean±SD (IQR) | P  |
|-----------------------------------|------------------------|----------------------------|----|
| No. of patients*                  | 693 (57.7)             | 507 (42.3)                 |    |
| Gestational age (wk)              | 38.3±1.4 (37.2-39.5)   | 38.4±1.2 (37.3-39.4)       | 1.15 |
| Gender*                           |                        |                            |    |
| Male                              | 353 (50.9)             | 268 (52.9)                 | 0.51 |
| Female                            | 340 (49.1)             | 239 (47.1)                 |    |
| Birth weight (g)                  | 3088.5±421.1 (2756.9-3409.3) | 3122.2±416.9 (2811.9-3450.7) | 1.11 |
| Apgar score (1 min)*              | 9                      | 9                          | 4.44 |
| Apgar score (5 min)*              | 9                      |                            | <0.05 |
| No. of days of life at discharge from birth | 2.8±1.6 (1.8-4.9) | 3.2±1.4 (1.8-4.8) | 1.45 |
| Age at PED presentation (day)     | 8.2±6.9 (4.0-17.4)     | 9.4±7.1 (4.1-16)           | 2.34 |
| Triage category*                  |                        |                            |    |
| P1                                | 25 (3.6)               | 5 (1.0)                    | 4.57 |
| Non-P1                            | 668 (96.4)             | 502 (99.0)                 |    |
| Method of referral*               |                        |                            |    |
| Self                              | 338 (48.8)             | 270 (53.2)                 | 4.87 |
| GP                                | 69 (10.0)              | 51 (10.0)                  |    |
| Polyclinic                        | 245 (35.3)             | 106 (21.0)                 |    |
| Other restructured hospitals      | 11 (1.6)               | 8 (1.6)                    |    |
| Private doctors                   | 12 (1.7)               |                            |    |
| KKH clinic                        | 12 (1.7)               | 64 (12.6)                  |    |
| Unknown                           | 6 (0.9)                | 8 (1.6)                    |    |

Data presented as *no. (%) or ’median. GP: general practitioner, IQR: interquartile range, KKH: KK Women’s and Children’s Hospital, PED: paediatric emergency department
169 (21.0%) were referred for outpatient follow-up, 4 (0.5%) were discharged against medical advice and 1 (0.1%) was referred to another hospital. The disposition of the patients with NNP was as follows: 169 (96.6%) patients were admitted; and 5 (3.4%) patients were discharged against medical advice.

The mean age of the admitted patients was similar to that of discharged patients [Table 4]. The ratio of male to female patients was similar between admitted and non-admitted patients [Table 4]. The mean gestational age of the admitted and non-admitted patients slightly differed; however, the difference was not statistically significant (p = 1.11). The median Apgar scores at 1 and 5 minutes were similar in both admitted and non-admitted patients. The mean age at discharge from the hospital after birth was lower for the admitted babies than for the non-admitted babies; however, this was not statistically significant (p = 1.45) [Table 4]. Similarly, the mean age at presentation to the PED for the admitted babies was lower than that for the non-admitted babies, but the difference was not statistically significant (p = 2.34) [Table 4].

The predominant triage category among the admitted and discharged neonates was the non-P1 category [Table 4]. The mean gestational age of the admitted patients was similar between admitted and non-admitted patients. The mean age at discharge of admitted patients was lower than that for the non-admitted babies; however, this was not statistically significant (p = 1.45) [Table 4].

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The predominant triage category among the admitted and discharged neonates was the non-P1 category [Table 4]. Nearly half of both the admitted and non-admitted neonates (52.1% and 53.7%, respectively) were brought into the PED by the parents themselves [Tables 2 and 5]. It is noteworthy that among the admitted neonates, the rates of self-referrals for well babies, less serious pathologies (e.g. colic) and more serious conditions (e.g. sepsis and apparent life threatening event [ALTE]) were comparable [Table 5]. 35.3% of the admitted neonates and 21.0% of the non-admitted neonates were referred to the PED after assessment by the polyclinic doctor. Similar proportions of patients (10.0%) were referred by the general practitioners in both the admitted and non-admitted categories.

**DISCUSSION**

Neonates remain a highly vulnerable population with variable physiological characteristics; caregiver (especially first-time parents) anxiety accompanied by a lack of information or education could contribute to increased visits to the PED. Shorter postpartum hospital stays, insufficient information or poor support and education during the perinatal and postpartum period might also contribute to increased PED use. Easy access to the PED, and greater availability of paediatricians and diagnostic tools might also lead to increased PED visits.

We found that the majority (50.7%) of the patients were brought in by the parents themselves, whereas 48.2% were...

| Table 5. Diagnoses of neonates admitted to the PED. |
|-----------------------------------------------|
| Diagnosis             | No. of patients admitted | % | No. of re-attendance | % | No. of self-referred patients | % |
|-----------------------|--------------------------|---|----------------------|---|-----------------------------|---|
| Total no. of diagnoses| 693                      |   | 100.0                |   | 100.0                       |   |
| Total no. of admitted patients | 693 |   | 100.0                |   | 100.0                       |   |
| Neonatal jaundice     | 468                      | 67.5 | 54.7                | 17 | 3.6                         | 70.8 | 158 | 33.8 | 35.4 |
| Neonatal pyrexia      | 136                      | 19.6 | 15.9                | 3 | 2.2                         | 12.5 | 90 | 66.2 | 20.2 |
| Others                | 63                       | 9.1  | 7.4                 | 2 | 3.2                         | 8.3   | 42 | 66.7 | 9.4  |
| GERD                  | 38                       | 5.5  | 4.4                 | 1 | 2.6                         | 4.2   | 34 | 89.5 | 7.6  |
| Viral URTI            | 37                       | 5.3  | 4.3                 | 0 | 0                            | 0      | 35 | 94.6 | 7.9  |
| Well baby             | 28                       | 4.0  | 3.3                 | 0 | 0                            | 0      | 22 | 78.6 | 4.9  |
| Sepsis                | 15                       | 2.2  | 1.8                 | 1 | 6.7                         | 4.2   | 11 | 73.3 | 2.5  |
| Urinary tract infection| 12                       | 1.7  | 1.4                 | 0 | 0                            | 0      | 10 | 83.3 | 2.2  |
| Conjunctivitis        | 11                       | 1.6  | 1.3                 | 0 | 0                            | 0      | 9  | 81.8 | 2.0  |
| Viral gastroenteritis | 11                       | 1.6  | 1.3                 | 0 | 0                            | 0      | 8  | 72.7 | 1.8  |
| LRTI                  | 10                       | 1.4  | 1.2                 | 0 | 0                            | 0      | 7  | 70.0 | 1.6  |
| Meningitis            | 10                       | 1.4  | 1.2                 | 0 | 0                            | 0      | 6  | 85.7 | 1.4  |
| Apparent life-threatening event | 7 | 1.0  | 0.8                 | 0 | 0                            | 0      | 2  | 50.0 | 0.5  |
| Ophthalmia neonatorum | 4                        | 0.6  | 0.5                 | 0 | 0                            | 0      | 2  | 50.0 | 0.5  |
| Erythema toxicum      | 4                        | 0.6  | 0.5                 | 0 | 0                            | 0      | 3  | 75.0 | 0.7  |
| Hypoglycaemia         | 1                        | 0.1  | 0.1                 | 0 | 0                            | 0      | 1  | 100.0 | 0.2 |
| Colic                 | 0                        | 0    | 0                   | 0 | 0                            | 0      | 0  | 0    | 0    |

Out of 1,200 patients, 693 were discharged with a total of 855 diagnoses, owing to some overlapping diagnoses. ‘% of total admitted patients’ uses 693 (no. of admitted patients) as the denominator. ‘% of total admitted diagnosis’ uses 855 (number of total admitted diagnoses) as the denominator. ‘% of specific discharge diagnosis’ uses the number of patients admitted for that specific diagnosis as the denominator. GERD: gastroesophageal reflux disease, LRTI: lower respiratory tract infection, PED: paediatric emergency department, URTI: upper respiratory tract infection.
The rate of visits with referral (48.0%) was higher in our study than those reported in other series: 24.5% in the study by Ruiz et al.; 21% in the study by Millar et al.; and 17.2% in the study by Calado et al. This difference could be attributable to the different healthcare structure, protocols and workflows, as well as the free access to hospital PEDs in other countries. In Singapore, routine jaundice checks are largely conducted in polyclinics or clinics (primary healthcare setting) at highly subsidised rates, and referrals are made accordingly to PEDs when bilirubin levels reach high enough to require phototherapy (according to a standardised workflow provided by our institution). In our study, it was noted that a large proportion (65.1%) of neonates with NNJ were referred by the polyclinics or other clinics.

PED visits in Singapore are not free, as compared to the countries where the other abovementioned series were conducted (Spain, Canada and Portugal), wherein PED visits are free or heavily insured. Parents of neonates in such countries might choose to directly go to the PED, where more specialised paediatric care and diagnostic tools are available, instead of seeing a general practitioner first, leading to an overall lower rate of referral to the PED from primary care.

The admission rate (57.7%) in our study was significantly higher than that in the studies by Millar et al. (32.9%), Ruiz et al. (26%) and Calado et al. (13%). This disparity could be attributed to a culmination of factors. The most common diagnosis in our study was NNJ, which differed from other series, where non-apparent pathology was the main diagnosis, followed by infant colic. Most cases of NNJ in our study required admission for further evaluation and treatment with phototherapy, which could account for the higher admission rates. Similar to the series by Ruiz et al., where a high rate of admission for fever without focalisation was observed, we observed a significant admission rate for NNP as well. This is likely contributed by the current practice in our PED, where limited investigations are performed for cases of NNP, as stated earlier. Another reason for the higher rate of hospital admissions would be the higher unpredictability of disease in newborns as well as the higher risk for serious bacterial infections.

This study has several limitations. Firstly, data regarding some of the neonatal demographics (e.g. gestational age, Apgar scores and day of discharge from birth) were missing, given that neonates seen in our PED might be out-born (born in hospitals other than KKH), limiting our access to some of these data. Secondly, data regarding mortality and long-term morbidity of the studied neonatal population was also unavailable; future studies should attempt to obtain these data. Thirdly, corrections for multiple comparisons of some of the statistical observations were not made, which could limit the validity of these observations. Another consideration is the inherent subjectivity during the prognostication and diagnostic process in the PED by different physicians.
In conclusion, we present a summary of our pertinent findings and the corresponding recommendations. NNJ and NNP were the two main diagnoses, both in the PED and during discharge from the hospital. The rate of referral from polyclinics and other clinics (48.0%) was higher than the rates reported in other series, which could be attributable to the different healthcare structure, protocols and workflows in the different studies. The rate of hospital admission (57.7%) was also higher than that reported in other series. These findings suggest that more robust infrastructure for community paediatrics, coordinated care programmes and potential facilities for outpatient management of jaundice in newborns can be considered to minimise PED visits and hospitalisations and the consequent exposure of neonates to these infective environments.

The finding that 87.0% of well babies that attended the PED were brought in owing to parental concerns without a prior consultation with another doctor suggests that there is a potential need to better educate caregivers with regard to the physiological characteristics of newborns and childcare needs. In addition, red flag signs and symptoms suggestive of disease should be initiated, preferably during the gestation period. Standardised educational materials can be provided in conjunction with educational sessions in the primary care settings (e.g. polyclinics), which would greatly help prepare caregivers in terms of what to expect after the birth of the newborn. This could also increase their awareness regarding the healthcare resources available to them. Other potential initiatives, for example the use of hotlines and ChatBots, such as the recently piloted ‘Urgent Paediatric Advice Line’ online service, should be considered.

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Conflicts of interest
There are no conflicts of interest.

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