Research Article

Time Trends in Complications of Prematurity and Respiratory Support 2002-2010 in Norway: Use of a National Patient Registry -

Anne Lee Solevåg and Inger Cathrine Kann

1The Health Services Research Centre HØKH, Norway
2The Department of Pediatric and Adolescent Medicine, Akershus University Hospital, Norway

Address for Correspondence: Anne Lee Solevåg, The Department of Pediatric and Adolescent Medicine, Akershus University Hospital, 1478 Lørenskog, Norway, Tel: +47 41469314, E-mail: a.l.solevag@medisin.uio.no

Submitted: 05 August 2016; Approved: 12 December 2016; Published: 03 January 2017


Copyright: © 2017 Solevåg AL, et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.
ABSTRACT

**Aim:** To describe time trends in complications and respiratory support in Norwegian preterm infants 2002-2010. To discuss strengths and limitations of using a national patient registry in epidemiological research.

**Methods:** A total population study using data from The Norwegian national patient registry (NPR) 2002-2010. Temporal changes in Respiratory Distress Syndrome (RDS), Bronchopulmonary Dysplasia (BPD), Retinopathy of Prematurity (ROP), Intraventricular Hemorrhage (IVH), Necrotizing Enterocolitis (NEC), in-hospital mortality and respiratory support were measured in multivariate logistic regressions using 2002 as reference year and adjusting for potential confounders.

**Results:** The odds ratio (OR) of RDS increased 65% from 2002-2010 (p<0.001), whereas the OR of BPD decreased 52% (p<0.001). The OR of ROP and IVH decreased and then increased again. NEC and in-hospital mortality did not change. Use of mechanical ventilation decreased and continuous positive airway pressure increased slightly.

**Conclusion:** The time trends in RDS and BPD cannot be explained by changes in birth weight, gestational age and multiple birth. Changes in registration practices might be an explanation and the results should be interpreted with caution. The total population character with a high number of patients represents a strength of our study. NPR data can be used for generation of hypotheses to be further explored.

ABBREVIATIONS

- RDS: Respiratory Distress Syndrome
- NPR: The Norwegian Patient Registry
- GA: Gestational Age
- CPAP: Continuous Positive Airway Pressure
- ROP: Retinopathy of Prematurity
- NICU: Neonatal Intensive Care Unit
- SGA: Small for Gestational Age
- PDA: Patent Ductus Arteriosus
- IVH: Intraventricular Hemorrhage
- NEC: Necrotizing Enterocolitis
- BPD: Bronchopulmonary Dysplasia
- ROP: Retinopathy of Prematurity
- NICU: Neonatal Intensive Care Unit
- SGA: Small for Gestational Age
- PDA: Patent Ductus Arteriosus
- IVH: Intraventricular Hemorrhage
- NEC: Necrotizing Enterocolitis
- PDA: Patent Ductus Arteriosus

INTRODUCTION

Preterm birth, i.e. prior to 37 completed weeks of gestation is the second leading cause of infant mortality in the industrialized world after congenital anomalies [1]. Improved prenatal and obstetric care has together with advances in the care of the newborn infant contributed to increased survival rates the last decades, particularly for infants born at the threshold of viability [2,3]. However, in the 1990s increased survival was associated with an increase in neurological and mental complications [4,5]. This trend seems to have changed after the turn of the century. However, still a large proportion of preterm infants suffer from significant long-term sequelae [4,6,7] with major morbidity in 68% of survivors born <27 weeks of gestation [7].

Many industrialized countries spend substantial resources on health surveillance through national patient registries, but the utility of such registries in epidemiological research varies [8,9].

The primary aim of this study was to describe the temporal changes 2002-2010 in complications of prematurity and respiratory support in preterm infants. The secondary aim was to explore and discuss strengths and limitations of using a national patient registry in epidemiological studies of the newborn population.

METHODS

The study was retrospective using individual register data from the Norwegian Patient Registry (NPR).

Setting and Participants

In Norway Gestational Age (GA) is based on routine ultrasound screening of pregnancies at 17-19 weeks of gestation. Birth weight is defined as appropriate for gestational age or not according to centiles developed by Skjærven et al. [10]. A prospective national registry of neonatal quality of care was introduced in Norway in 2006 with complete registrations from 2008.

We defined an infant as being <1 year of age and born in the year of observation and identified 557,790 infants admitted to hospital 2002-2010 in the NPR [Table 1]. Of these, 33,882 were preterm, i.e., had a gestational age <37 weeks at birth.

Data Collection and Definitions

Our unit of observation was preterm infants born the same year as they were admitted to hospital. All observations were censored at the end of the year or when the infant was transferred to a different hospital. For 15% of the observations we did not have birth date, only birth year. For these observations we used the first admission date in the year of birth as a proxy for birth date.

We used the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) Version for 2010 and the diagnose codes for Respiratory Distress Syndrome (RDS), extremely low birth weight (<500g, 500-749g and 750-999g), very low birth weight (1000-1499g), and low birth weight (1500-1999g and 2000-2499g), Small for Gestational Age (SGA) (birth weight < 2SD below the mean or <10 centile), fetus and newborn affected by multiple pregnancy, Patent Ductus Arteriosus (PDA), extreme immaturity (GA<28 weeks), other preterm infants (GA ≥28 but <37 weeks), Bronchopulmonary Dysplasia (BPD) originating in the perinatal period, Retinopathy of Prematurity (ROP), Intraventricular Hemorrhage (IVH) and Necrotizing Enterocolitis (NEC) were included.

Definitions according to the Norwegian Association of Pediatricians:

**RDS**

 Criterion A or B:

A. All preterm infants < 32weeks of gestation receiving surfactant based on clinical criteria.

B. Preterm infants < 37 weeks of gestation with respiratory distress lasting > 24 hours requiring supplementary oxygen and respiratory support (mechanical ventilation, continuous positive airway pressure (CPAP), high-flow nasal cannula) to maintain oxygen saturation >90%. Exclusion of other disease such as meconium aspiration, pulmonary hypoplasia or sepsis/pneumonia.
BPD

Pulmonary status should be evaluated at 28 days and 36 weeks postmenstrual age and both criteria should be present: A. Changes on chest x-ray suggestive of BPD B. Prolonged oxygen requirement to keep an oxygen saturation >90% and/or need for respiratory support (mechanical ventilation, CPAP, high-flow nasal cannula).

IVH

Intraventricular non-traumatic hemorrhage in fetus or newborn Papile grade 1
- Isolated subependymal hemorrhage.
Intraventricular non-traumatic hemorrhage in fetus or newborn Papile grade 2
- Subependymal hemorrhage with break-through to the ventricles without dilatation of the ventricles.
Intraventricular non-traumatic hemorrhage in fetus or newborn Papile grade 3-4
- Subependymal hemorrhage with break-through to the ventricles with dilatation of the ventricles. Parenchymal hemorrhage not mandatory.

NEC

One of the following criteria present: i) A + B or ii) C. A. One or more of the clinical signs i) bilious aspirate or vomit, ii) distended abdomen, iii) macroscopic/microscopic (guaiac) stool blood B. One or more of the radiological signs (x-ray/ultrasound) i) pneumatosis, ii) hepatobiliary air, iii) free intraperitoneal gas or iv) fluid suspect of perforation. C. Surgical NEC

Patients with mild to moderate RDS generally start CPAP treatment with a positive end expiratory pressure of 5 cmH O and this can be increased slightly in the case of difficulties with oxygenation, except in extremely preterm infants with little or no spontaneous breathing efforts at birth. These infants are commonly intubated in the delivery room. Relative CPAP failure criteria leading to intubation and mechanical ventilation include an FiO₂>0.4 and/or rising pCO₂ above 8 kPa (60 mmHg) or apnea requiring mask ventilation more than twice in an hour.

The NPR assigned patients with a new Identification (ID) number each calendar year and in each hospital the patients were admitted to before 2008. After 2008 the NPR allows for tracking individual patients between years and hospitals. Our definition of an infant secures that data after 2008 is comparable to before 2008. The NPR does not allow for identifying exact GA below 28 weeks. As outcomes differ widely between GA 24 and 28 weeks, we stratified our results according to birth weight categories as an approximation to stratification by gestational weeks. We calculated Odds Ratio (OR) each year for the different outcomes adjusted for birth weight and other confounders, and unmeasured changes captured in the variable “year”. The year variable captures the variation in complications that is not captured by the other predictors included in the regression.

In this total patient registry study we found that the risk of RDS...
Table 1: The study population 2002-2010.

<table>
<thead>
<tr>
<th>Year</th>
<th>RDS</th>
<th>BPD</th>
<th>ROP</th>
<th>IVH</th>
<th>NEC</th>
<th>Death</th>
<th>CPAP</th>
<th>Mechanical ventilator</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>551</td>
<td>120</td>
<td>52</td>
<td>91</td>
<td>10</td>
<td>72</td>
<td>777</td>
<td>356</td>
<td>5,372</td>
</tr>
<tr>
<td>2003</td>
<td>542</td>
<td>114</td>
<td>51</td>
<td>88</td>
<td>10</td>
<td>87</td>
<td>886</td>
<td>349</td>
<td>5,432</td>
</tr>
<tr>
<td>2004</td>
<td>484</td>
<td>96</td>
<td>39</td>
<td>77</td>
<td>8</td>
<td>69</td>
<td>899</td>
<td>327</td>
<td>5,372</td>
</tr>
<tr>
<td>2005</td>
<td>539</td>
<td>112</td>
<td>45</td>
<td>113</td>
<td>15</td>
<td>60</td>
<td>952</td>
<td>345</td>
<td>5,372</td>
</tr>
<tr>
<td>2006</td>
<td>497</td>
<td>82</td>
<td>32</td>
<td>92</td>
<td>11</td>
<td>95</td>
<td>950</td>
<td>336</td>
<td>5,372</td>
</tr>
<tr>
<td>2007</td>
<td>638</td>
<td>98</td>
<td>20</td>
<td>81</td>
<td>11</td>
<td>71</td>
<td>1,085</td>
<td>347</td>
<td>5,432</td>
</tr>
<tr>
<td>2008</td>
<td>665</td>
<td>100</td>
<td>38</td>
<td>57</td>
<td>11</td>
<td>66</td>
<td>978</td>
<td>284</td>
<td>5,432</td>
</tr>
<tr>
<td>2009</td>
<td>695</td>
<td>59</td>
<td>60</td>
<td>55</td>
<td>7</td>
<td>83</td>
<td>746</td>
<td>251</td>
<td>5,432</td>
</tr>
<tr>
<td>2010</td>
<td>761</td>
<td>59</td>
<td>102</td>
<td>57</td>
<td>11</td>
<td>58</td>
<td>772</td>
<td>343</td>
<td>5,432</td>
</tr>
</tbody>
</table>

Table 2: Fraction of preterm patients with RDS, BPD, IVH, ROP, NEC, in-hospital mortality, mechanical ventilator and CPAP treatment, by birth weight.*

<table>
<thead>
<tr>
<th>Weight Category</th>
<th>RDS</th>
<th>BPD</th>
<th>ROP</th>
<th>IVH</th>
<th>NEC</th>
<th>Mortality</th>
<th>CPAP</th>
<th>MV</th>
<th>Observations (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm &lt;37 weeks of GA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;500 g or less</td>
<td>56.76 %</td>
<td>29.73 %</td>
<td>10.81 %</td>
<td>12.16 %</td>
<td>4.05 %</td>
<td>56.76 %</td>
<td>47.30 %</td>
<td>63.51 %</td>
<td>74</td>
</tr>
<tr>
<td>500-749 g</td>
<td>67.17 %</td>
<td>33.40 %</td>
<td>13.32 %</td>
<td>20.83 %</td>
<td>6.00 %</td>
<td>34.33 %</td>
<td>57.22 %</td>
<td>65.48 %</td>
<td>533</td>
</tr>
<tr>
<td>750-999 g</td>
<td>64.53 %</td>
<td>28.88 %</td>
<td>13.35 %</td>
<td>21.02 %</td>
<td>2.93 %</td>
<td>14.08 %</td>
<td>78.79 %</td>
<td>65.08 %</td>
<td>547</td>
</tr>
<tr>
<td>1000-1499 g</td>
<td>59.38 %</td>
<td>19.79 %</td>
<td>8.33 %</td>
<td>18.40 %</td>
<td>1.74 %</td>
<td>9.03 %</td>
<td>77.43 %</td>
<td>54.11 %</td>
<td>288</td>
</tr>
<tr>
<td>1500-1999 g</td>
<td>38.46 %</td>
<td>7.69 %</td>
<td>0.00 %</td>
<td>0.00 %</td>
<td>0.00 %</td>
<td>7.69 %</td>
<td>46.15 %</td>
<td>30.77 %</td>
<td>13</td>
</tr>
<tr>
<td>&gt;2000 g</td>
<td>15.56 %</td>
<td>0.00 %</td>
<td>1.56 %</td>
<td>0.00 %</td>
<td>0.00 %</td>
<td>0.00 %</td>
<td>3.13 %</td>
<td>1.56 %</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>54.08 %</td>
<td>24.22 %</td>
<td>10.46 %</td>
<td>17.06 %</td>
<td>3.13 %</td>
<td>20.25 %</td>
<td>58.45 %</td>
<td>53.02 %</td>
<td>1,788</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight Category</th>
<th>RDS</th>
<th>BPD</th>
<th>ROP</th>
<th>IVH</th>
<th>NEC</th>
<th>Mortality</th>
<th>CPAP</th>
<th>MV</th>
<th>Observations (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Term infants &gt;37 weeks of GA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;500 g or less</td>
<td>34.78 %</td>
<td>17.39 %</td>
<td>17.39 %</td>
<td>4.35 %</td>
<td>0.00 %</td>
<td>39.13 %</td>
<td>39.13 %</td>
<td>52.17 %</td>
<td>23</td>
</tr>
<tr>
<td>500-749 g</td>
<td>57.79 %</td>
<td>30.52 %</td>
<td>22.73 %</td>
<td>11.04 %</td>
<td>3.25 %</td>
<td>15.58 %</td>
<td>70.78 %</td>
<td>51.95 %</td>
<td>154</td>
</tr>
<tr>
<td>750-999 g</td>
<td>57.76 %</td>
<td>15.10 %</td>
<td>11.02 %</td>
<td>7.14 %</td>
<td>2.04 %</td>
<td>3.47 %</td>
<td>80.00 %</td>
<td>40.82 %</td>
<td>490</td>
</tr>
<tr>
<td>1000-1499 g</td>
<td>44.97 %</td>
<td>6.10 %</td>
<td>4.94 %</td>
<td>6.40 %</td>
<td>0.56 %</td>
<td>2.81 %</td>
<td>61.88 %</td>
<td>22.63 %</td>
<td>2,673</td>
</tr>
<tr>
<td>1500-1999 g</td>
<td>21.01 %</td>
<td>0.96 %</td>
<td>0.34 %</td>
<td>1.81 %</td>
<td>0.09 %</td>
<td>1.01 %</td>
<td>35.84 %</td>
<td>7.57 %</td>
<td>5,522</td>
</tr>
<tr>
<td>&gt;2000 g</td>
<td>10.19 %</td>
<td>0.29 %</td>
<td>0.00 %</td>
<td>0.65 %</td>
<td>0.03 %</td>
<td>0.57 %</td>
<td>19.04 %</td>
<td>3.56 %</td>
<td>9,018</td>
</tr>
<tr>
<td>Total</td>
<td>13.73 %</td>
<td>1.27 %</td>
<td>0.79 %</td>
<td>1.31 %</td>
<td>0.13 %</td>
<td>0.93 %</td>
<td>22.93 %</td>
<td>6.20 %</td>
<td>32,094</td>
</tr>
</tbody>
</table>

*The change in fractions in each weight category follows fairly the same pattern as described in Figure 1, Respiratory Distress Syndrome (RDS), Continuous Positive Airway Pressure (CPAP), Retinopathy of Prematurity (ROP), Bronchopulmonary Dysplasia (BPD), Intraventricular Hemorrhage (IVH), Necrotizing Enterocolitis (NEC), Mechanical Ventilator (MV)
Table 3: Extraction of multiple logistic regression estimating time trends in odds ratio (OR) of RDS, BPD, ROP, IVH, NEC and in hospital mortality, coefficients of time trend in Figure 1.

<table>
<thead>
<tr>
<th>Year - Reference category - 2002</th>
<th>Gestational age - Reference category - &lt;28 weeks</th>
<th>Patent ductus arteriosus</th>
<th>Multiple birth</th>
<th>Gender - Reference category - Male</th>
<th>Birth weight - Reference category - &gt;2500 g</th>
<th>Birth weight 500-999g</th>
<th>Birth weight 750-999g</th>
<th>Birth weight 1000-1499g</th>
<th>Birth weight 1500-1499g</th>
<th>Birth weight 2000-2499g</th>
<th>Birth weight &lt;500g</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>0.958 (0.818) (1.102)</td>
<td>0.930 (0.685) (1.294)</td>
<td>0.962 (0.665) (1.446)</td>
<td>0.759 (0.586) (0.988)</td>
<td>0.283 (0.226) (0.358)</td>
<td>0.557 (0.323) (0.860)</td>
<td>0.222 (0.171) (0.298)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>0.879 (0.759) (1.030)</td>
<td>0.887 (0.666) (1.290)</td>
<td>0.868 (0.659) (1.340)</td>
<td>0.902 (0.652) (1.246)</td>
<td>0.988 (0.805) (1.242)</td>
<td>1.64 (0.834) (3.262)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>0.912 (0.794) (1.059)</td>
<td>0.970 (0.722) (1.304)</td>
<td>0.888 (0.589) (1.430)</td>
<td>0.992 (0.652) (1.456)</td>
<td>1.012 (0.810) (1.271)</td>
<td>1.007 (0.410) (2.444)</td>
<td>1.38 (0.915) (2.084)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2006</td>
<td>0.834 (0.670) (1.086)</td>
<td>0.841 (0.646) (1.080)</td>
<td>0.832 (0.439) (1.501)</td>
<td>0.989 (0.730) (1.359)</td>
<td>1.010 (0.718) (1.449)</td>
<td>1.64 (0.741) (3.639)</td>
<td>0.955 (0.566) (1.632)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>0.972 (0.790) (1.245)</td>
<td>0.961 (0.713) (1.381)</td>
<td>0.948 (0.606) (1.662)</td>
<td>0.918 (0.605) (1.519)</td>
<td>1.012 (0.809) (1.258)</td>
<td>1.002 (0.396) (2.584)</td>
<td>1.25 (0.805) (1.954)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>1.026 (0.804) (1.328)</td>
<td>0.882 (0.606) (1.207)</td>
<td>0.857 (0.496) (1.512)</td>
<td>0.947 (0.692) (1.377)</td>
<td>1.019 (0.827) (1.276)</td>
<td>1.011 (0.394) (2.576)</td>
<td>1.27 (0.810) (1.959)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>1.032 (0.760) (1.351)</td>
<td>0.919 (0.627) (1.352)</td>
<td>0.956 (0.599) (1.513)</td>
<td>0.995 (0.743) (1.375)</td>
<td>1.023 (0.836) (1.280)</td>
<td>1.014 (0.397) (2.585)</td>
<td>1.29 (0.812) (1.966)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>1.050 (0.789) (1.382)</td>
<td>0.943 (0.667) (1.384)</td>
<td>0.982 (0.629) (1.514)</td>
<td>1.039 (0.769) (1.385)</td>
<td>1.037 (0.846) (1.290)</td>
<td>1.017 (0.398) (2.594)</td>
<td>1.31 (0.815) (1.973)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Respiratory Distress Syndrome (RDS), Bronchopulmonary Dysplasia (BPD), Retinopathy of Prematurity (ROP), Intraventricular Hemorrhage (IVH), Necrotizing Enterocolitis (NEC), Confidence Interval (CI)

Figure 1: Estimated time trend in Respiratory Distress Syndrome (RDS), Retinopathy of Prematurity (ROP), Bronchopulmonary Dysplasia (BPD), Intraventricular Hemorrhage (IVH), Necrotizing Enterocolitis (NEC), and stillbirth hazard ratio of in-hospital mortality 2002-2010. Adjusted for low birth weight, prematurity, patent ductus arteriosus, gender and multiple birth. Odds ratio using 2002 as reference year, coefficients from the rest of the multiple regression analysis presented in Table 3.

Figure 2: In-hospital mortality by weight categories, Kaplan-Meier failure estimates.
numbers are somewhat higher than those found in the NPR where 0.98% of infants with a birth weight 1500g-2000g and 7.43% of infants with a birth weight 1000-1499g were diagnosed with BPD. The incidence of ROP in the Swedish study was 2.7-6.6% which was also higher that what we found in preterm infants of similar weight [13] [Table 2].

OR for ROP increased from 2007-2010 in our study. Some studies conducted the past 15 years indicate a decrease in the incidence of ROP [14], whereas others found no change [15-18]. A more cautious use of supplementary oxygen reduces the incidence of severe ROP [19]. However, major changes in oxygen targeting in preterm infants did not take place during the study years.

IVH decreased in our study except for 2004-2005 and 2009-2010. According to Volpe [20], the incidence of any grade IVH is 10-30%. In our data, the incidence was on average 2.15%, varying from 1.31% for moderately preterm infants to 17.06% for extremely preterm infants (GA <28 weeks) [Table 2].

We found a low and stable incidence of NEC, on average 0.29%, and 5.39% if birth weight 500-749g [Table 2]. Following the introduction of prenatal steroids and surfactant treatment, as well as multicenter randomized controlled trials such as the COIN trial [21,22], CPAP has replaced mechanical ventilator treatment in many preterm infants [23]. Data from the Norwegian NPR confirmed this trend when interpolating data per hospital.

CONFOUNDERS

Birth weight and GA have been used as predictors of long-term disability [24-26]. In our study, birth weight and GA as well as SGA and male gender were predictors of RDS in a multiple regression analysis. Interestingly, multiple birth was associated with a lower incidence of RDS compared to singletons of the same weight, GA etc. Contrary to common beliefs and population data [11], gender did not influence any of the main outcomes, except RDS when we adjusted for SGA, weight and GA.

LIMITATIONS

We did not adjust for prenatal steroids and surfactant treatment. However, these factors can be assumed to have been constant throughout the study period. We did not differentiate between different stages of ROP, moderate and severe BPD; or grading of IVH. The retrospective nature of the study, and the fact that the results rely on routine reporting practices pose challenges to interpretation of the results. Changes in reporting practices associated with the introduction of the prospective Norwegian registry of neonatal quality of care cannot completely explain changes in OR after 2008, since there is no consistent trend in OR for all the different outcomes 2008-2010. However, as can be seen from Table 2, a number of infants with GA <28 weeks has been registered with a birth weight >2500g. This may be due to missing data resulting in a ‘default’ registration of ‘normal birth weight’ or alternatively, the infant’s weight at the time of transfer to a local level 2 NICU has been registered as birth weight. Finally, the temporary ID numbers assigned to newborn infants in Norway make registry data less reliable the first year of life. Some of the infants in our study have been included multiple times when admitted to several hospitals with the same diagnoses, and incidence of the study outcomes except mortality is likely to be overestimated. Despite this, except for IVH we found fewer complications in the extremely preterm group than in the prospective Swedish EXPRESS study [7]. Some of the differences in outcome data in the NPR and the EXPRESS study should be attributed to the retrospective nature of our study.

Despite these limitations, we claim that the NPR can be used to describe temporal changes in the outcomes of interest. The results do not indicate that the variables described in this paper were influenced systematically by the introduction of the Norwegian registry of neonatal quality of care in 2008, since some variables increased, some decreased, whereas other variables remained stable after 2008.

Strengths of our study include the population-based design and the fact that our data reflect preterm morbidity the last decade. Many epidemiological studies of extremely preterm infants are from the early 2000s [2]. Also, few studies have studied temporal changes the way we did in the present study.

In conclusion, the risk of RDS increased whereas BPD risk decreased. ROP decreased from 2002-2006 and IVH from 2005-2009 followed by an increase. There was neither a change in NEC, nor in hospital mortality. Use of mechanical ventilation decreased and use of CPAP increased slightly. There is a need for cautious interpretation of data from the national patient registry. However, the data can be useful for estimating time trends to be further explored.

REFERENCES


