



Does centralisation of acute obstetric care reduce intrapartum and first-week mortality? An empirical study of over 1 million births in the Netherlands



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ABSTRACT

In this hypothetical analysis with retrospective cohort data (1,160,708 hospital births) we estimated outcome of centralisation of acute obstetric care, i.e., closure of 10 hospitals (out of 99) in The Netherlands. The main outcome was predicted intrapartum and first-week mortality (further referred to as neonatal mortality) for several subgroups of patients affected by two centralisation scenarios: (1) closure of the 10 smallest hospitals; (2) closure of the 10 smallest hospitals, but avoiding adjacent closures. Predictions followed from regression coefficients from a multilevel logistic regression model. Scenario 1 resulted in doubled travel time, and 10% increased mortality (210 [0.34%] to 231 [0.38%] cases). Scenario 2 showed less effect on mortality (268 [0.33%] to 259 [0.32%] cases) and travel time. Heterogeneity in hospital organisational features caused simultaneous improvement and deterioration of predicted neonatal mortality. Consequences vary for subgroups. We demonstrate that (in The Netherlands) centralisation of acute obstetric care according to the 'closure-of-the-smallest-rule' yields suboptimal outcomes. In order to develop an optimal strategy one would need to consider all positive and negative effects, e.g., organisational heterogeneity of closing and surviving hospitals, differential effects for patient subgroups, increased travel time, and financial aspects. The provided framework may be beneficial for other countries considering centralisation of acute obstetric care.

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1. Introduction

Dutch foetal and early neonatal (first-week) mortality rates exceed the European average [1,2]. Structural inadequacies in the provision of care were discovered as major contributors [3]. In response, a national Steering Group on Pregnancy and Birth, on behalf of the Dutch Ministry of Health, issued several recommendations [4]. One recommendation addressed the observed inadequate availability of 7*24 h acute obstetric care stating availability within 15 minutes of 'qualified professionals' (midwives,

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gynaecologists, paediatricians, anaesthesiologists, and operating theatre staff; 'qualified' in terms of seniority) [4,5]. However, small hospitals reported to be unable to satisfy these demands with existing on-call coverage schemes. Moreover, larger hospitals were unwilling to do so as there are complex limited regulations regarding the reimbursement of so-called 'availability (standby) costs' of 'qualified professionals'. Consequently, centralisation of acute obstetric care services was considered, implying a reduction of acute services in about half of all hospitals with a parallel redistribution of qualified professionals from small local to nearby larger hospitals.

1.1. Availability of existing data

Centralisation of acute obstetric care services has been considered in other countries as well [6–8]. Previous studies at best used an ecological study design, were descriptive rather than comparative, and were heterogeneous in design and results [7–11]. Moreover, they follow from different settings (e.g., Nordic countries or the United States) and have been done in different time periods. Most studies conclude a strong pro- or against-centralisation policy comparing risk-adjusted outcome in small (low level care) hospitals versus outcome in large (high level care) hospitals, without modelling hospital performance itself [7–12]. In Norway, Moster et al. [9] performed a population-based study using data on 1.7 million births from The Norwegian Medical Birth Registry. Neonatal mortality was compared between several geographical areas characterised by the volume of the majority of the maternity units. Overall neonatal mortality was 1.2–2.2 times higher in areas with the majority of women giving birth in small scale maternity units (500 or less births annually) compared to areas with the majority of births in large scale units (>3000 births annually). As this study lacked risk and casemix information, its conclusion in favour of centralisation may be biased in the presence of area related risk differences as shown in other studies [9]. Some studies focus on either high risk or low risk patient groups [8,10–12]. Bartels et al. [12] and Phipps et al. [11] studied the effect of NICU level on neonatal mortality for high risk infants, both showing (up to 94%) higher (adjusted) neonatal mortality in smaller and lower level NICUs favouring centralisation. Finally, two studies which focused on low risk patients show conflicting results [8,10].

1.2. Arguments pro and con centralisation

Common arguments in favour of centralisation are: increase in continuity of high level care, volume-related better care provision, access to rapid intervention during delivery, quick resuscitation of the newborn, and rapid identification and management of newborn infants with unexpected morbidities (e.g., congenital anomalies) in large and higher level hospitals [9]. An important reason opposing centralisation is the increased travel time to hospital, with inherent increased risk for adverse outcome, especially for high risk women or out-of-hospital delivery [7]. Ravelli et al. [13] showed a 17–52% increased risk for intrapartum and neonatal mortality with travel time

to hospital of 20 minutes or more [13]. Another reason against centralisation is that in high risk oriented hospitals, low risk births are expected to be less 'natural' with an increased risk for (obstetric) interventions and corresponding increased costs [14]. Moreover, financial aspects of centralisation policy need to be considered, e.g., resource distribution costs or education and salary costs for consultants (obstetrics, paediatrics, anaesthesiology, etc.), and the investment costs required to rise substantially the scale of a perinatal unit [15]. The inter-dependency of acute obstetric care services with, e.g., paediatric/neonatal services and anaesthesiology services should also be considered. These services may be at risk of collapse as the number of physicians required to sustain on-call coverage may be no longer available in small hospitals after acute obstetric care has been centralised [16]. Finally, particularly for The Netherlands where about 20% of births still occur at home under supervision of a midwife [17], increased travel time to hospital will compromise these (low risk) women in their choice to opt for a birth at home.

The key question is whether direct effects of centralisation on patient outcomes are to be expected. An overall positive outcome would more easily justify the mentioned disutilities. In this study we estimated the direct effects on intrapartum and first-week mortality (for convenience further referred to as neonatal mortality) when 10 small hospitals (out of 99 providing obstetric care) would hypothetically be closed according to two plausible centralisation scenarios. The effects of closing were estimated by a predicted redistribution of patient flow (depending on their zip code of residency) to the next-nearest hospital, taking into account (1) maternal and child characteristics, (2) acute referral status, (3) travel time to hospital in unplanned (acute) births, and hospital related factors such as (4) day and time of birth, (5) the hospital's organisational 7*24 h characteristics, and (6) any additional non-specific hospital effects not accounted for by the previously mentioned factors. The net consequences in terms of neonatal mortality, and travel time to hospital were then calculated for all individual women redistributed from the hypothetically closed hospitals to the remaining hospitals, to allow for a trade-off of positive and negative effects.

2. Materials and methods

2.1. General approach

This study was issued by the so-called society of SAZ-hospitals, which represents the interests of about 40 small general hospitals in The Netherlands; from an international perspective these are still relatively large with an average of around 300 beds per hospital. These hospitals are located throughout The Netherlands, either within the 'Randstad' conurbation (the densely populated western part of the Netherlands) or outside. Centralisation of care primarily will affect SAZ hospitals.

Our general approach was as follows. In step 1, we estimated the impact of maternal, child, and hospitals' organisational characteristics in terms of intrapartum and first-week (neonatal) mortality, using multilevel logistic regression analysis. Next, in step 2, we identified all

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