**An evaluation of the costs and consequences of Children Community Nursing teams**

Running head: An evaluation of CCN teams

HINDE S1, ALLGAR V2, RICHARDSON G1, SPIERS G3, PARKER G4 AND BIRKS Y4

1Centre for Health Economics, University of York

2Health Sciences, University of York

3Institute of Health & Society, Newcastle University

4Social Policy Research Unit, University of York

Corresponding author:

Sebastian Hinde, MSc

Centre for Health Economics,

Alcuin ‘A’ Block,

University of York,

Heslington,

North Yorkshire,

YO10 5DD.

+44 (0)1904 321455

Sebastian.Hinde@york.ac.uk

Conflicts of Interest:

No conflict of interest has been declared by the authors.

Funding Statement:

This project was funded by the National Institute for Health Research, Health Services and Delivery Research programme (project number 11/1015/12) and will be published in full in Health Services Delivery Research (in press). Further information available at: http://www.nets.nihr.ac.uk/projects/hsdr/11101512

This report presents independent research commissioned by the National Institute for Health Research. The views and opinions expressed by authors in this publication are those of the authors and do not necessarily reflect those of the NHS, the NIHR, MRC, CCF, NETSCC, the HS&DR programme or the Department of Health.

**Abstract**

Aims

Recent years has seen an increasing shift towards providing care in the community, epitomised by the role of Children’s Community Nursing (CCN) teams. However, there have been few attempts to use robust evaluative methods to interrogate the impact of such services. This study sought to evaluate whether reduction in secondary care costs, resulting from the introduction of two CCN teams, were sufficient to offset the additional cost of commissioning.

Methods

Among the potential benefits of the CCN teams is a reduction in the burden placed on secondary care through the delivery of care at home, it is this potential reduction which is evaluated in this study via a two part analytical method. Firstly, an interrupted time-series analysis utilised Hospital Episode Statistics data to interrogate any change in total paediatric bed days as a result of the introduction of two teams. Secondly, a costing analysis compared the cost savings from any reduction in total bed days with the cost of commissioning the teams. This study used a retrospective longitudinal study design as part of the TraCCS trial, which was conducted between June 2012 and June 2015.

Results

A reduction in hospital activity after introduction of the two nursing teams was found, (9,634 and 8,969 fewer bed days), but this did not reach statistical significance. The resultant cost saving to the NHS was less than the cost of employing the teams.

Conclusion

The study represents an important first step in understanding the role of such teams as a means of providing a high quality of paediatric care in an era of limited resource. While the cost saving from released paediatric bed days was not sufficient to demonstrate cost effectiveness, the analysis does not incorporate wider measures of healthcare utilisation and non-monetary benefits resulting from the CCN teams.

Keywords:

Nursing, Quantitative Analysis, Child Nursing, Community Care, Bed Days, Cost Minimisation, Interrupted Time Series Analysis

**Introduction**

In recent years there has been a policy drive towards increasing the delivery of children’s healthcare at home and in the community, with Children’s Community Nursing (CCN) teams identified by the Department of Health as a service that can support this aim.1 While a recognition that delivering care for children closer to home has been growing since the 1960’s the policy was advocated in the 2004 National Services Framework for Children, Young People and Maternity Services and continued in the later (2008) Transforming Community Services programme,2 both of which highlighted the importance of providing care closer to home while maintaining accessibility and the provision of timely services. The crux of this policy is to ensure that children are cared for in the most appropriate setting but where high quality safe care can still be achieved. However, the delivery of care closer to home also has the potential to relieve pressure on other NHS services and thus possibly reduce costs. For example, a national survey of care closer to home teams found that core objectives of these services typically included admission avoidance and facilitating early discharge – functions that may, in theory, reduce secondary care activity.3

*Background*

The potential for CCN teams to contribute to admission avoidance and reductions in the length of hospital stay for both acutely ill children and those with long term conditions has been suggested. Both of which should be captured by observable reductions in bed days.

Despite the national interest in providing care closer to home via CCN teams and the hypothetical impact on secondary care use, not all areas have access to a CCN team and there is currently limited evidence to support their efficacy in achieving a reduction in secondary care use.3 Other work 4 has demonstrated the difficulties of isolating the impact of CCN services on secondary care activity given the presence of other organisational changes and population factors. However, evidence concerning the quality of care delivered by these teams suggests a positive effect, particularly among families whose children have complex and ongoing needs.5 There is a remaining gap in the current evidence base which limits the ability of commissioners to consider the question of cost-effectiveness. These factors are important at both a local level, when constructing a business case for a CCN team, and at a national level to inform broad governmental policy.

**The Study**

*Aims*

This research was conducted in the context of a broader study examining the impact of CCN services on quality of care, secondary care activity, and costs.6 This paper reports findings from the component examining secondary care and costs in relation to two general CCN teams. The primary aim is to evaluate whether the reduction in secondary care costs, resulting from the introduction of the CCN team, were sufficient to offset the additional cost of commissioning the team. The hypothesis considered was that the introduction of a CCN team would be expected to lead to a relative reduction in secondary care use.

*Design*

The study hypothesis was tested through a two part analysis, conducted as part of the Transforming community health services for children and young people who are ill (TraCCS) trial, conducted June 2012 to June 2015.

Firstly, the change in paediatric bed days as a direct result of the CCN team being introduced was evaluated through an interrupted time series (ITS) analysis over a 7 year time period (April 2006 to March 2013). This was to estimate the scale of the change in secondary care use (if any) over the analysis period. In cases such as the provision of a CCN team, where the construction of a randomised design is either unfeasible or unethical, a quasi-experimental approach, such as the ITS analysis is used. This technique provides a historic control for comparison. The existence of time series data, such as the Hospital Episodes Statistics (HES) dataset, allowed for an assessment of the impact of a the introduction of a CCN team on hospital activity by considering the size and trends in bed days before and after the teams were introduced.

Combining historic- and case-control approaches allows for the strongest form of ITS analysis. However, in the case of this analysis a robust case-control approach was not feasible as, independent of the availability of CCN teams, sites vary in a number of socioeconomic and other factors, making the identification of a sufficiently similar site against which to conduct a case-control impossible. Comparison of trends in bed days between the site and national trends were possible, however, these are not considered an appropriate comparator by which to directly adjust the site trends due to the significant variation in underlying factors across the country.

The cost implications of the CCN team’s introduction were evaluated. This was done by estimating the cost of commissioning the team, based on the salary and non-salary costs. Any cost implications of the change in secondary care use are then estimated. To do so an average cost per bed day is applied to the estimated change in activity from the ITS analysis to provide an annual cost saving due to reduced hospital activity as a direct result of the CCN teams’ introduction. This estimate is then compared to the estimated cost of each CCN team to determine the total cost implication of the teams.

*Sample*

Two Primary Care Trusts (PCTs, which became Clinical Commissioning Groups during the study period) acted as case sites for the evaluation. Both were located within the same geographic region, and each had funded the introduction or expansion of a general CCN service as part of a wider regional reconfiguration of children’s services. The two resultant CCN teams, each provided by a different NHS trust (one a care trust and community based, the other a hospital trust and hospital based) and serving different areas, operated using a model that provided nursing care for children with acute, long-term, complex and end of life needs. Both aimed to prevent acute admission and facilitate early discharge from hospital, although one team prioritised admission avoidance whilst the other also provided case management for children with complex conditions. Details of each of the two CCN teams operating in each site are given in Table 1. Due to the independence of the teams they are evaluated separately.

*[Table 1 here]*

*Data Collection*

The total number of bed days were extracted for children aged between 14 days and 15 years inclusive from the Hospital Episode Statistics (HES) dataset. The total bed days per 100,000 population were calculated by taking the total number of bed days in each month and divided this by appropriate ONS mid-year population estimates for the PCTs, multiplied by 100,000. Additional data were extracted and evaluated around average length of stay, admissions, complex care conditions and a range of sub-group analyses which are not the primary focus of this paper and reported elsewhere.6

Data were extracted for each site for at least two years before and at least two years after the intervention in order to minimize the effect of seasonal variation. Early analysis indicated that there were serious discontinuities in the HES data before April 2006, which may be due to introduction of Payment by Results. Therefore, no data were extracted before this date. Data were extracted up to March 2013.

Data to inform the cost analysis were drawn from a number of sources. The makeup (and therefore cost) of the CCN teams were taken from questionnaires completed by the teams at a number of time-points throughout the analysis. Unit costs for both parts of the costing analysis were drawn from published estimates, including the Unit Costs of Health & Social Care volume7 and the NHS Reference Costs.8

*Ethical Considerations*

The study was approved by an NHS ethics committee in 2012, and all relevant local governance approvals obtained.

*Data Analysis*

*ITS Analysis*

The ITS analytical approach taken is shown in Figure 1. The analysis assumes that the historic control period is indicative of some fixed underlying trend (positive, negative or flat) that would occur without the introduction of the CCN team in that area. At the point of introduction there is hypothesised to be some step change in the level of activity in the outcome of interest, after which (in the post-intervention period) there is a potential change in the slope of the trend line. This approach allows the intervention to impact both the level of outcome at the point of intervention (the ‘change in level’) and the trend in the outcome over time (the ‘change in slope’).

*[Figure 1 here]*

*Cost analysis methods*

The costing analysis takes the perspective of the NHS and Personal Social Services (PSS), with all costs being discounted at a rate of 3.5% per annum, such that future costs and benefits are given less weight in the analysis than contemporary ones.9 As with the ITS analysis, the costing analysis were conducted for each team individually. This analysis is used to estimate whether the introduction of the CCN teams represented a cost-saving to the NHS i.e. the cost of having a team in place (part 1 below) was offset by the cost saving from a reduction in bed days (part 2 below).

Part 1: the cost to the NHS of having a CCN team in place

A ‘bottom up’ costing approach was taken to estimate the cost to the NHS, focussing on the staffing levels of each team. These are based on three questionnaires completed by each CCN team detailing whole time equivalent (WTE), stratified by band 3 to 8 qualified nurse categories, and estimated distance travelled to attend care visits. The estimates across the three questionnaires were averaged to provide a mean team structure per annum across the analysis period.

The unit costs estimated were drawn from the PSSRU reference cost estimates for qualified nurses, and include estimates of non-salary costs (e.g. training, provision of offices).

Part 2: The cost implications of a change in bed days within the NHS

An average unit cost, per bed day was applied to the findings of the ITS analysis. Unit costs were drawn from the NHS Reference Costs 2012-13.8

Once applied to the change in bed days as a result of the CCN team, from the ITS analysis, the estimated unit cost was adjusted to the size of the at risk population, that is, the size of the paediatric population covered by the CCN team in each site, drawn from ONS estimates. This provides an estimate of the total cost of a change in bed days over the analysis period.

**Results**

The results of the ITS and costing analyses are presented in Table 2, including the relevant notation from Figure 1 for the variables of interest. The Table highlights a number of important findings of this analysis.

Change in bed days: community based generic CCN team (site 1)

The total change in bed days over the analysis period for site 1, taking into account the size of the population, was 9,634 fewer bed days but this did not reach statistical significance. Applying the unit cost of a bed day to this reduction and annualising it over the full period gives a cost saving to the NHS of £578,272, as reported in Table 2.

Change in bed days: hospital based generic CCN team (site 2)

A similar result was seen for site 2, with 8,969 fewer bed days occurring over the analysis period. However, as with site 1 the change did not reach statistical significance. This gives an annualised cost saving to the NHS of £501,030.

*[Table 2 here]*

The cost of the CCN teams

The annualised estimated cost of each of the CCN teams indicate the cost of having each team in place varies between the two sites, costing £1,111,049 per year for the community based team (site 1) and £698,042 for the hospital based team (site 2). This variation reflects the differences in the makeup of the teams presented in Table 1 earlier.

Bringing the costs together

Combining the two elements of the costing analysis yields a net annualised cost impact of the CCN teams on the NHS for the two sites over the analysis periods, presented in Table 2. Neither of the analyses indicated a mean cost saving to the NHS, with the annual cost to the NHS estimated as £532,777 for site 1 and £197,012 for site 2. It is important to note that site 2’s lower additional cost to the NHS is not to say it is the more effective or cost-effective CCN team. As this analysis includes no estimate of health effect it is impossible to comment on cost-effectiveness or to make a clear comparison between the two sites. However, given the level of uncertainty in the data there is a 26% and 35% probability that this finding is incorrect (in sites 1 and 2, respectively) and that the teams have had a cost saving effect.

**Discussion**

The overall aim of this study was to examine the introduction of CCN teams in two areas and the cost savings to the NHS due to any reductions in hospital activity, captured by total bed days. Our findings suggest that while a consistent reduction in bed days appears to have resulted in both areas, the change was not of sufficient magnitude to reach statistical significance. Furthermore, the estimated change was not of sufficient scale for the cost savings from reduced bed days to outweigh the cost of commissioning the teams. While our findings show that the commissioning of CCN teams is not a cost saving measure when considering bed days alone, the wider impact of the teams on other areas of NHS activity and quality of care does not preclude their cost-effectiveness or indeed potential for cost-saving.

*Implications for policy and practice*

In an NHS where resources are increasingly restricted, services must make a case for their value. Thus, a consideration of the cost implications of CCN services is important. However, inherent in any discussion of service costs is the challenge of attempting to maximise two outcomes: the delivery of children’s care closer to home, and the drive to make cost and efficiency savings in the NHS. The evidence presented here indicates the cost savings associated with reduced bed days were not sufficient to offset the costs of the teams. This would suggest that such teams do not, in this instance, align to the NHS efficiencies agenda. Yet at the same time they are advocated by policy as the better option of care for children and evidence consistently underlines the value of CCN teams in promoting high quality care. 4, 10. Ultimately, this is a conflict that raises questions for both policy and practice about whether the considerations of costs should, in this particular service context, outweigh considerations of need and quality. However, the relative novelty and high variation in current practice among CCN teams in the English healthcare setting implies the most cost-effective or cost-minimizing practice may be yet to emerge.

*Limitations of this research*

This research has highlighted many of the challenges associated with quasi-experimental analyses, such as the ITS analysis which underpins this study. Primarily, the lack of a randomised control greatly limits the ability to determine causal inference in this case between the HES estimates of total paediatric hospital bed days and the introduction of the CCN teams. While both analysis figures presented appear to show a reduction in bed days in both areas through the ITS analysis, the large level of background ‘noise’ in the data from unrelated changes in hospital policy and demands for healthcare erodes any statistical significance. Furthermore, our ITS analysis assumes a fixed pre- and post-implementation slope, while in reality the marginal effect of the CCN teams is likely to diminish over the long term there was insufficient theoretical or empirical evidence with which to define this relationship.

While the results presented here suggest the CCN teams did not lead to a cost saving to the NHS from reduced hospital activity, this result is by no means definitive. The definition of ‘activity’ is limited to bed days and thus overlooks other areas of potential impact of the CCN teams, for example around primary and emergency care. Thus, the cost of the teams may be offset if other possible reductions in service use were measured and observed. Impact on primary care was not measured in this research. Furthermore, the limited focus of the analysis on costs alone fails to value the non-monetary benefits of the CCN teams to their patients and families.

To attempt to overcome these limitations a number of parents in site 1 were approached to complete questionnaires concerning the 6 month period before allocation to a CCN team as well as the 6 month period after, these included a wider definition of medical care utilisation (covering all relevant primary and secondary care) in addition to out of pocket payments and lost days of employment to provide care. Using the wider, parent reported, estimate of healthcare, the children with complex conditions were found to be associated with an average of £9,160 less healthcare utilisation (not including the cost of the CCN care delivered), and parents an average of £585 better off in the 6 months after allocation to the CCN team. However, parents reported difficulty in accurately remembering their children’s care over the periods and only two full questionnaires were returned (with an additional three completed for the 6 months prior to allocation, and 12 completed for the 6 months after). As a result, while this approach allowed for both a wider definition of healthcare utilisation and costs to the parents and carers, the potential bias was felt by the authors to be too significant to inform the primary analysis of this study. The questionnaire additionally included an adapted version of the Medical Home Family Index questionnaires which suggested an overall high level of satisfaction with the level of care, which remained high throughout the analysis period. Further details of these analyses are available in the main study report.6

**Conclusions**

The analyses conducted here as part of a wider study provide a number of important findings. Primarily, the ITS analysis found that, while a reduction in hospital activity measured in bed days was seen as a result of the CCN team in the majority of analyses, it did not reach statistical significance. Secondly, the costing analyses found that, on average, neither of the CCN teams were expected to be associated with a cost saving when considering the reduction in bed days alone.

In conclusion, while these results show potential for CCN teams to reduce hospital activity, further research is needed in a number of areas. The ethical and methodological challenges of evaluating a CCN team using a robust methodology highlight that the approach presented remains the most robust so should be developed further, incorporation of wider definition of impact of teams on NHS activity, derivation of marginal unit cost estimates, and the estimation of the health consequences of the teams in terms of their ability to maintain or stabilise the health of the children. Furthermore, the relative novelty and service driven nature of the CCN model of care suggests that the most cost-effective service design has yet emerged.

References

**1.** Department of Health. NHS at Home: Community Children’s Nursing Services. *London: Department of Health.* 2011.

**2.** Department of Health. Transforming Community Services: Ambition, Action, Achievement. Transforming Services for Children, Young People and Families. London: Department of Health; 2009.

**3.** Parker G, Corden A, Heaton J. Experiences of and influences on continuity of care for service users and carers: synthesis of evidence from a research programme. *Health Soc Care Community.* Nov 2011;19(6):576-601.

**4.** Callery P, Kyle RG, Banks M, Ewing C, Kirk S. Enhancing parents' confidence to care in acute childhood illness: triangulation of findings from a mixed methods study of Community Children's Nursing. *Journal of Advanced Nursing.* 2013;69(11):2538-2548.

**5.** Kirk S. Families' experiences of caring at home for a technology-dependent child: a review of the literature. *Child Care Health Dev.* Mar 1998;24(2):101-114.

**6.** Spiers G, Allgar V, Richardson G, et al. Transforming Community Health Services for Children and Young People who are Ill: A Quasi-Experimental Evaluation. *HS&DR* 2016;4(25).

**7.** PSSRU. Unit Costs of Health & Social Care 2013. *PSSRY: University of Kent.* 2013.

**8.** Department of Health. 2012-13 national schedule of reference costs. *Department of Health: London.* 2013.

**9.** NICE. Guide to the methods of technology appraisal. 2013.

**10.** Spiers G, Parker G, Gridley K, Atkin K. The psychosocial experience of parents receiving care closer to home for their ill child. *Health & Social Care in the Community.* 2011;19(6):653-660.

**Tables**

**Table 1:** Overview of the key factors of each site

|  |  |  |  |
| --- | --- | --- | --- |
| **Site** | **Summary of team function** | **Needs covered** | **Team makeup** |
| **1: Community based** | Acute admission avoidance (prioritised by the hospital based team) and facilitate early discharge. Provision of care for children with complex conditions (including case management by the community based team) and end of life care | Acute, long-term, complex, palliative and end of life | Around 19 Whole Time Equivalent (WTE), bands 5-7 children’s nurses with some specialist nurses, some with non-medical prescribing. Referrals taken from a range of health professionals as well as parents (self-referrals). |
| **2: Hospital based** | Around 11 WTE, bands 4-7, health care assistant and children’s nurses with some specialist nurses. Referrals taken from a range of health professionals, but not parents. |

**Table 2**: Results of the ITS analysis and combined analyses

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Site and analysis | Long term change in slope /100,000 | | | Short term change in rate /100,000 | Total bed days change over analysis period (average per year) | Cost of team to NHS, annualised | Change in bed days cost, annualised | Net cost impact | Probability of being cost saving |
| Slope before team | Slope after team | Difference in slope (p- value) | Change  (p-value) |
| Site 1 | 10.49 | -2.85 | -13.34 (0.238) | -22.98 (0.900) | -9,634  (-1,959) | £1,111,049 | -£578,272 | £532,777 | 26% |
| Site 2 | 10.62 | 2.57 | -8.05 (0.274) | -58.2 (0.594) | -8,969  (-1,764) | £698,042 | -£501,030 | £197,012 | 35% |

**Figures**

**Figure 1:** Analytical approach taken by ITS analysis

