



Evaluation of the Neonatal Oral Antibiotics at Home pathway at RDUH



Health Innovation South West
Final Report, March 2025

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Executive Summary

Context

Currently in the UK, standard management of suspected early-onset neonatal infection (EOI) involves a minimum of 36 hours of intravenous (IV) antibiotics. Antibiotics are typically stopped after 36 hours if the baby is well, C-Reactive Protein (CRP) results are reassuring, and any cultures taken are negative. However, when there are ongoing concerns about neonatal infection, intravenous antibiotics are continued for up to 7 days.

Intravenous antibiotics carry a number of disadvantages including increased duration of hospital stay and multiple intravenous cannulations, a procedure which is both painful and technically challenging. Recommended IV antibiotics for EOI include gentamicin, which carries risks to the baby's renal system and hearing.

Oral antibiotics have not been widely used in high-resource settings for the treatment of EOI due to concerns about efficacy, particularly around gastrointestinal absorption in the neonate. However emerging evidence supports the safety of a transition from IV to oral therapy in a specific cohort of babies receiving treatment for suspected EOI. This switch is backed by high-quality studies confirming its efficacy, safety, and cost-effectiveness (Keji et al, 2022; Carlsen, 2024).

In June 2024, the Exeter site of the Royal Devon University Hospital NHS Foundation Trust (RDUH) introduced a switch from IV to oral antibiotics after 36 hours for eligible babies. The Neonatal Oral Antibiotics at Home (NOAH) pathway aims to:

- ❧ reduce length of stay in hospital,
- ❧ improve experience of babies and families,
- ❧ reduce number of gentamicin doses and reduce associated risk of harm,
- ❧ reduce costs to NHS, and
- ❧ increase workforce capacity.

RDUH (Exeter) has a local neonatal unit (LNU) with a birth rate of approximately 3,500 per year.

Findings

The aim of this evaluation was to establish the efficacy, acceptability and feasibility of implementing the NOAH pathway within the neonatal patient pathway, in the UK.

Although a relatively small pilot, in one acute Trust in the UK, findings are consistent with existing evidence that suggests several benefits of implementing a NOAH pathway.

Reach

The NOAH pathway was created for term babies who are well following 36 hours of antibiotics (peak CRP no higher than 50 and falling, no positive blood culture or CSF (Cerebrospinal Fluid) culture) but the clinician feels a prolonged course of antibiotics would be beneficial.

In the six months between 3rd June and 3rd December 2024, 139 babies were screened for sepsis on the LNU at RDUH (Exeter). Of these babies, 93 were discharged after 36 hours of intravenous antibiotics with no further concerns about infection, 46 continued on antibiotics, of whom 19 were retained on the ward to complete a full course of IV antibiotics, and 27 babies were put on the NOAH pathway to complete their course of antibiotics orally at home.

Babies on the pathway had an average birth weight of 3,665g (range 2,699 to 4,780g) and were born at term (average 39 weeks and 6 days). Babies' peak CRP (C-Reactive Protein, a marker for inflammation) was less than 50 and all CRP levels were reducing at discharge.

It is estimated that between 50 and 60 babies would be eligible for the NOAH pathway per year, approximately 1.5% of the Trust's birth rate.

Effectiveness

Records of antibiotic usage on the Neonatal Unit also show a drop in gentamicin use following the implementation of the NOAH pathway: babies avoid an average (median) of 2 doses (mean of 1.7) of gentamicin each, as well as a reduction in overall use of intravenous antibiotics.

The introduction of the NOAH pathway resulted in baby and parent avoiding an average of 2.7 days of hospital stay (145 days annualised). Assuming an average cost of £452 per day¹, this is an annual cost avoidance of around £65,540,

¹ 2022/23 National Tariff Payment System: Non-mandatory guide and benchmark prices. Cost of local neonatal unit, Neonatal Critical Care, Special Care, with External Carer. https://www.england.nhs.uk/wp-content/uploads/2020/11/22-23NT_Non-mandatory-guide-prices.xlsx

but more importantly, this represents beds that are free and staff that are available for more babies who need support.

A comparison of re-presentations between those on the NOAH pathway and a similar cohort of babies from a previous year suggests that **the introduction of the NOAH pathway at RDUH (Exeter) did not increase rates of re-presentation or readmission to hospital within the first 28 days of life.**

Switching neonates from intravenous to oral antibiotics had a positive environmental impact: reduced carbon emissions associated with reduced length of stay and reduced travel emissions for visitors; and a reduction in the use of carbon-intensive IV medication.

Overall, implementing the NOAH pathway for one year is estimated to save around 8,230kgCO₂e, equivalent to planting 255 to 380 trees.

Acceptability

Both survey and interview data suggest a high level of acceptability of the model from both parents and staff, who show enthusiasm and support for the pathway and satisfaction with their experience. Both parents and staff understood their roles and felt confident to manage the baby at home. Parents reported feeling confident to administer medication, and staff were comfortable having babies on the pathway.

Overall feasibility

Evidence from prospectively collected data from patient records, surveys and interviews demonstrated that clinicians are identifying the appropriate babies for the pathway, and that all babies on the pathway had positive outcomes. The pilot reached the number of babies expected, within the timeframe, suggesting a potential annual reach of around 54 babies within RDUH (Exeter).

Conclusion

This evaluation supports existing evidence for the benefits of switching well babies with suspected EOI from intravenous to oral antibiotics, demonstrates evidence of a strong implementation model and highlights the positive parent, baby and staff experience of the pathway. Further research is needed, particularly regarding the impact of such models on antimicrobial resistance and the neonatal gut microbiome.

Evaluation of the implementation of the Neonatal Oral Antibiotics at Home pathway in Exeter site of the Royal Devon University Hospital NHS Foundation Trust

1. Background

Currently in the UK, standard management of suspected early-onset neonatal infection (EOI) involves a minimum of 36 hours of intravenous (IV) antibiotics. Antibiotics are typically stopped after 36 hours if the baby is well, CRP results are reassuring, and any cultures taken are negative. However, when there are ongoing concerns about neonatal infection, intravenous antibiotics are continued for up to 7 days.

Intravenous antibiotics carry several disadvantages, including increased duration of hospital stays, and multiple intravenous cannulation attempts, a procedure which is both painful and technically challenging. The process of cannulation may involve the separation of babies from their parents.

Oral antibiotics have not been widely used in high-resource settings for the treatment of EOI due to concerns about efficacy, particularly around gastrointestinal absorption in the neonate. However emerging evidence supports the safety of a transition from IV to oral therapy in a specific cohort of babies receiving treatment for suspected EOI. This switch is backed by high-quality studies confirming its efficacy, safety, and cost-effectiveness (Keji et al, 2022; Carlsen, 2024).

A meta-analysis of the use of oral antibiotics for neonatal infections (Keij et al, 2019) showed that although administration of oral antibiotics may take longer to reach their maximum concentration and have a lower bioavailability, adequate

levels are usually reached and there is no evidence of there being a difference in relapse rates or mortality.

More importantly, studies implementing a switch from IV to oral antibiotics in neonates show no difference in reinfection rates or adverse events (Keij et al, 2022; Carlsen et al, 2024).

1.1 Neonatal Oral Antibiotics at Home (NOAH) pathway

The Neonatal Oral Antibiotics at Home (NOAH) strategy offers a clinical approach for neonates with suspected early-onset bacterial infection, by switching from IV antibiotics to oral therapy at home. This project is aimed at reducing hospital stays while maintaining the efficacy of treatment. Historically, IV antibiotics have been used in neonates due to concerns about the efficacy of oral antibiotics in this population. However, emerging evidence supports the use of oral antibiotics in this context, with studies showing comparable serum concentrations and no increase in adverse events.

Key pharmacokinetic studies (Autret et al, 1988; Gras-Le Guen, 2007) demonstrate that oral amoxicillin can maintain effective therapeutic levels, even in neonates, with no significant adverse effects. The RAIN trial (Keij et al 2022), a multicentre randomised trial, confirmed that early switching to oral amoxicillin-clavulanic acid was both safe and effective, reducing hospital stays significantly with no increase in adverse events, readmission or treatment failure. Similarly, Carlsen et al.'s cohort study in Denmark showed that switching to oral therapy after 36–48 hours significantly reduced hospital stays, with no readmissions for infection.

Additional smaller studies by Gyllensvärd et al (2020) and Manzoni et al (2009) also support the practice of early oral antibiotic switching, emphasising reductions in antibiotic duration, hospital costs, and improved outcomes such as breastfeeding rates. Furthermore, a recent rapid evidence review published in the Archives of Disease in Childhood (Gifford, 2024) concluded that switching to oral antibiotics is acceptable for clinically stable, feeding well, term neonates with culture-negative early-onset infection, providing there is proper outpatient monitoring in place.

In conclusion, the evidence supports the safety and effectiveness of switching from IV to oral antibiotics in clinically stable neonates with suspected early-onset infection. This strategy reduces hospital stays and promotes earlier discharge, without increasing the risk of adverse events.

In June 2024, the Exeter site of the Royal Devon University Hospital NHS Foundation Trust (RDUH) introduced a switch from IV to oral antibiotics after 36 hours for eligible babies. The aim of introducing the new pathway is to:

- ❏ reduce length of stay in hospital,
- ❏ improve parents' experience (keeps families together),
- ❏ reduce number of gentamicin doses and reduce associated risk of harm from the gentamicin,
- ❏ reduce costs to NHS, and
- ❏ increase work force capacity.

1.2 Devon and the South West

Devon is a large county with 38% of the population living in rural areas and just 10% of the population living within 30km of more than one trust with a neonatal unit (either a Special Care Baby Unit, a Local Neonatal Unit, or a Neonatal Intensive Care Unit), compared to around 75% of the population of England (figure 1).

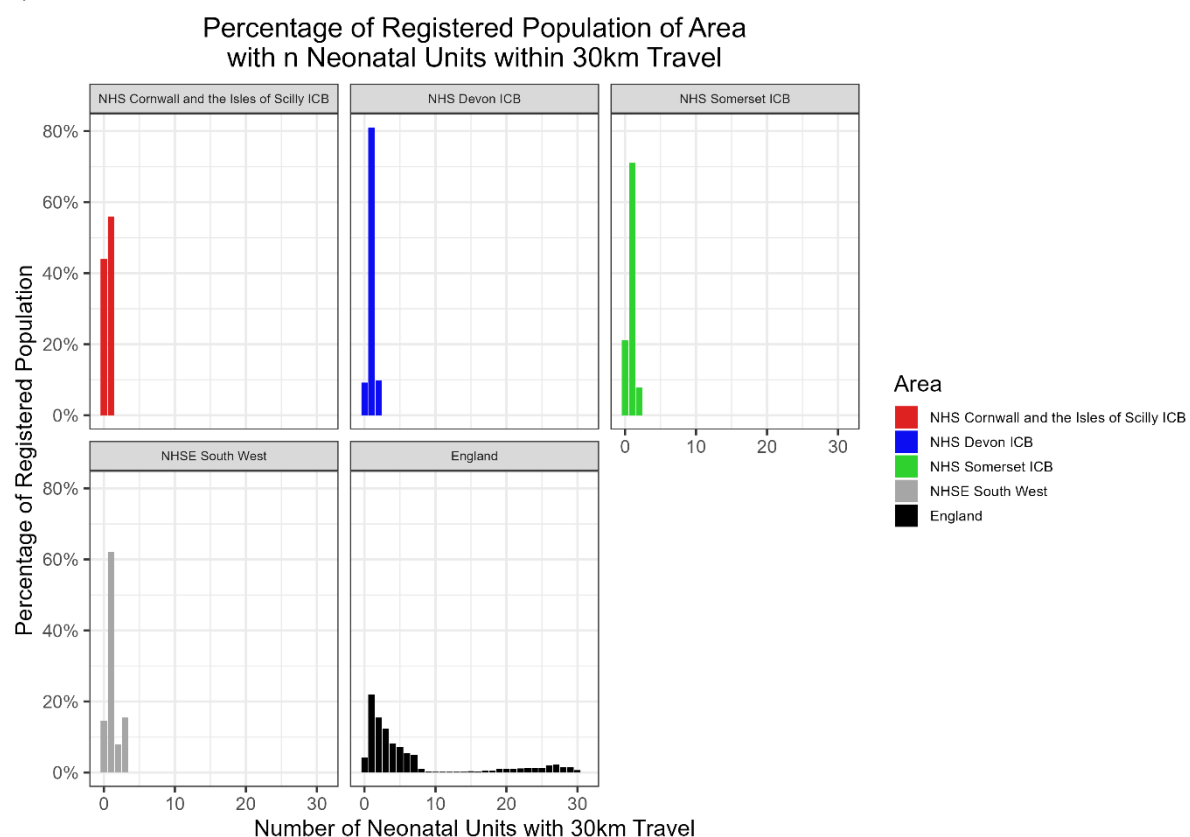


Figure 1. Percentage of registered population living within 30 km of 0, 1 or more neonatal units.

Due to the way communities and housing are organized across Devon, many families (one in four) live more than 20km from an acute hospital (figure 2). This means a prolonged inpatient stay would place parents and their newborns far from their support network.

Further, the size and rurality of Devon and the surrounding counties of Cornwall and Somerset impact upon plurality and proximity of care with 60% of the population of Devon living more than 50kms from a Neonatal Intensive Care Unit (compared to 12% across England, Figure 3). This means that not only are people having to travel significant distances but the availability of beds within these units is critical for the population they serve.

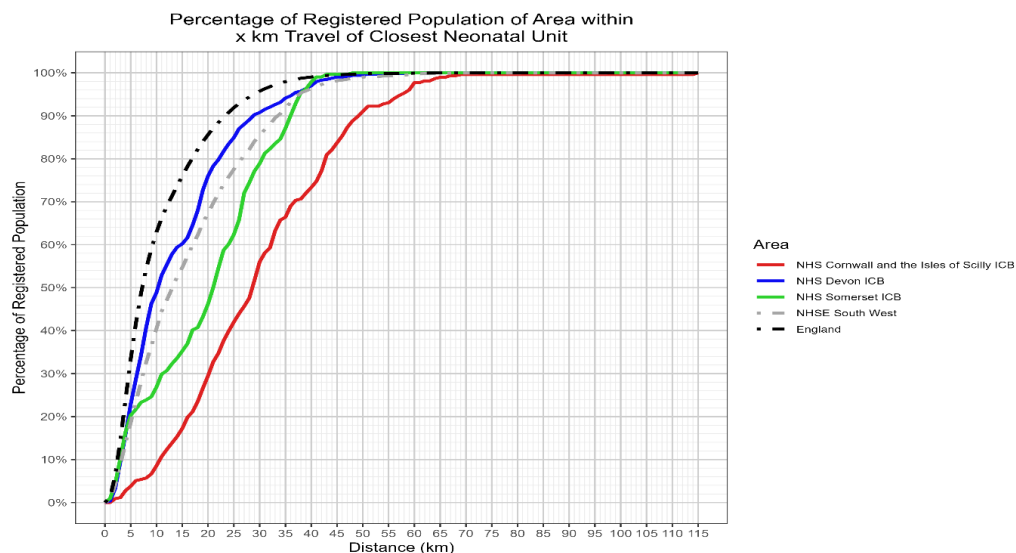


Figure 2. Percentage of registered population living within x km of nearest neonatal unit.

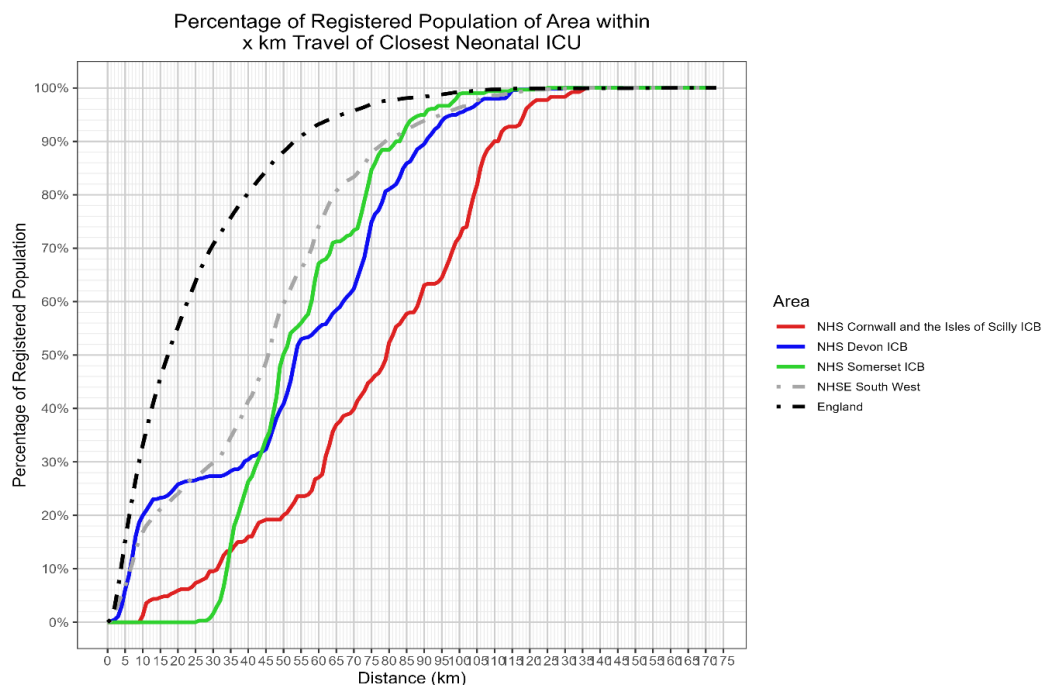


Figure 3. Percentage of registered population living within x km of nearest neonatal intensive care unit.

2. Evaluation

Health Innovation South West have been working in collaboration with the RDUH's Neonatal team at their Exeter site to evaluate the NOAH pathway. The evaluation aims to generate learning about how best to support babies to go home on oral antibiotics.

The evaluation aims to answer the following questions:

1. Who is being offered and who is accepting the NOAH pathway?
2. What is the parent experience of their baby being discharged early with oral antibiotics?
3. What are the medical team views about discharging babies and managing the risk of babies continuing their antibiotic treatment at home?
4. What is the impact of the NOAH pathway on parents':
 - a. Ability to bond with their child?
 - b. Levels of anxiety around separation?
 - c. Mental health?
 - d. Travel time/cost?
5. What is the impact of the NOAH pathway on system resources:
 - a. Length of stay?
 - b. Medication use?
6. What is the impact of the NOAH pathway on babies':
 - a. Use of gentamicin?
 - b. Re-cannulation?
7. What are the impacts of the NOAH pathway on factors associated with environmental impact?
8. What can be learned to support future delivery and spread of the NOAH pathway?

This evaluation report aims to demonstrate the impact of the implementation of the NOAH pathway in practice, it does not aim to demonstrate whether the pathway is a clinically safe means of treating suspected infection in neonates.

2.1

Methods

To address the evaluation questions, a mixed-methods evaluation design was implemented between January and July 2024. Data were gathered from the following sources:

- ❧ Interview with Clinical lead for NOAH at RDUH (Exeter)
- ❧ Staff survey (n=29)
- ❧ Parent survey (n=10)
- ❧ Parent interviews (n=3)
- ❧ Data extracted from patient records for the period of 3rd June to 3rd December 2024
- ❧ Data extracted from patient records for the year 2022.
- ❧ Secondary data sources were used as references for unit costs and carbon emission calculations and are referenced in the text.

2.1.1

Qualitative analysis

Interviews were transcribed using an automated transcription service and edited by the researchers. Thematic analysis was employed across the open text responses to surveys. Emergent themes are discussed within the text against each relevant evaluation question.

2.1.2

Quantitative analysis

Descriptive statistics from the survey data and routinely collected system data are presented in the text.

3. Results

3.1 Reach

3.1.1 What is the NOAH pathway?

Term (born at more than 37 weeks gestation) babies with suspected early onset sepsis (baby has risk factors or is clinically unwell) will have a cannula inserted, have blood taken and be started on intravenous antibiotics. Antibiotics will be stopped after 36 hours if they do not have a rise in their inflammatory markers (C reactive protein (CRP)) and they are clinically well, with negative cultures.

However, for a cohort of babies where despite being clinically well, there is an ongoing concern about infection (most commonly a CRP rise), the decision is made that that baby requires a prolonged course of antibiotics. If the peak CRP is not higher than 50, these babies are eligible for the NOAH pathway.

Further, to be eligible, CRP must be reducing. If a baby has a first CRP that's low and a second CRP that's raised, a CRP will be repeated to ensure the rise is not continuing. Babies are also excluded if they have positive blood culture or CSF (Cerebrospinal Fluid) culture and if they're preterm.

This process for the identification of babies for the pathway is shown on the following page.

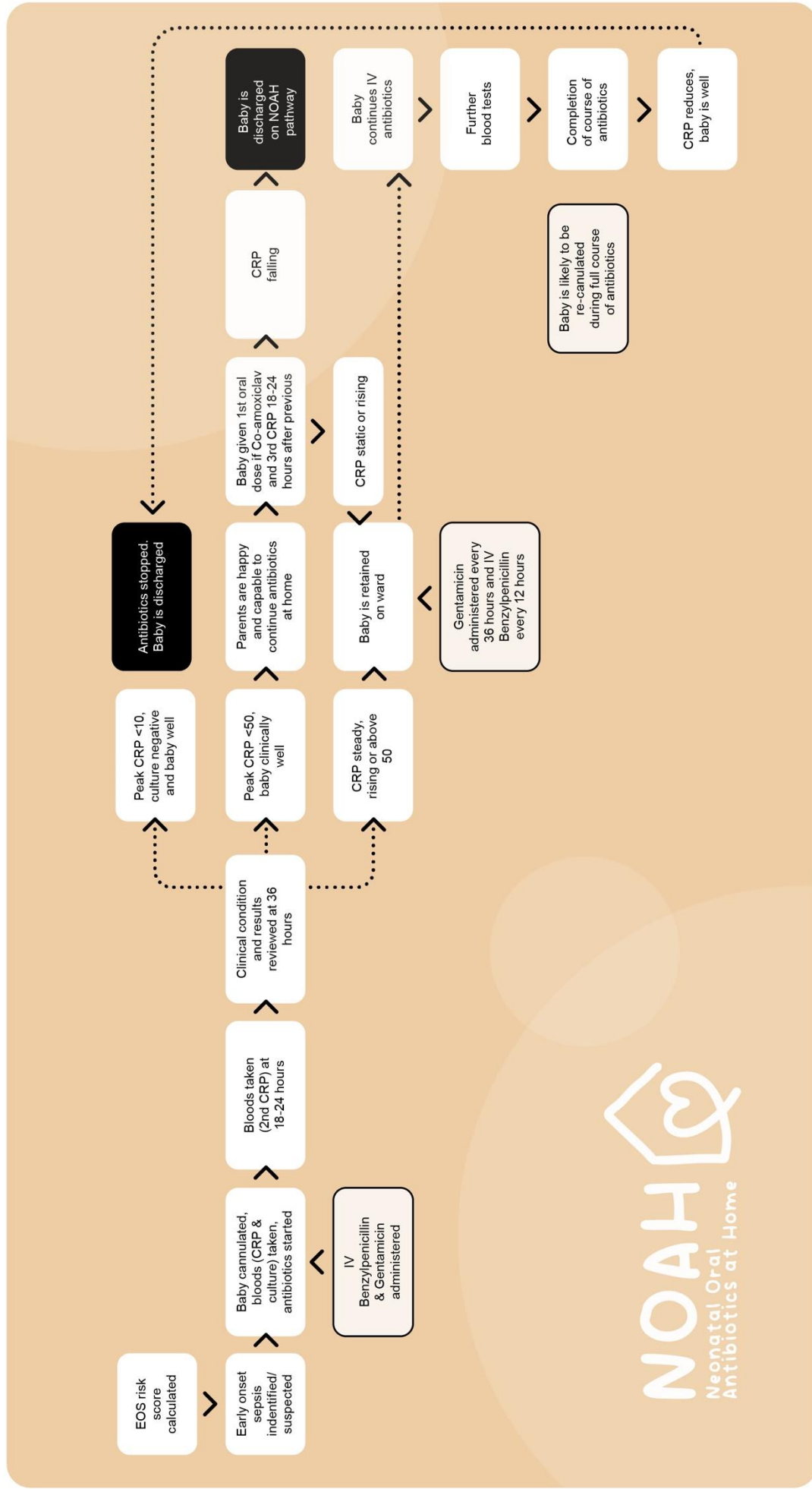


Figure 4. Pathways for babies with confirmed or suspected sepsis.

To give some examples of scenarios explaining why babies are started on antibiotics, the three parents interviewed explained why their baby had required them after birth.

So it was because I had an infection in labour, and then when she was born, I believe she had a temperature as well. So I believe that's why she was prescribed them.

Parent 1 (Interview)

He came out with the cord around his neck, and then he needed PEEP (positive end-expiratory pressure) for about 30 minutes, and then he was on CPAP for about four or five hours, I think, and then I was swabbed for Group B strep, when he had the respiratory distress, which came back positive, and his CRP was, I think, 16 or something. So, yeah, he was started on the antibiotics. I think as he went over to neonates on the CPAP, that was like part of the septic screen.

Parent 2 (Interview)

So after the delivery, I had trace markers for infection in my blood, and I believe [baby] also had them. I started on antibiotics a bit sooner than he did. But during the night, his breathing was a bit fast, so neonatal got involved, just to sort of check it out. And I think as part of that, bloods were taken, which did show the trace infection going up and so at that point, he was started on the intravenous antibiotics every 12 hours, and then a separate set at 36 hours and some bloods taken to see if we could identify within three days if it was something more specific and it turned out to be just general, and the antibiotics, he responded well to.

Parent 3 (interview)

The process followed on the NOAH pathway is described in the figure below.

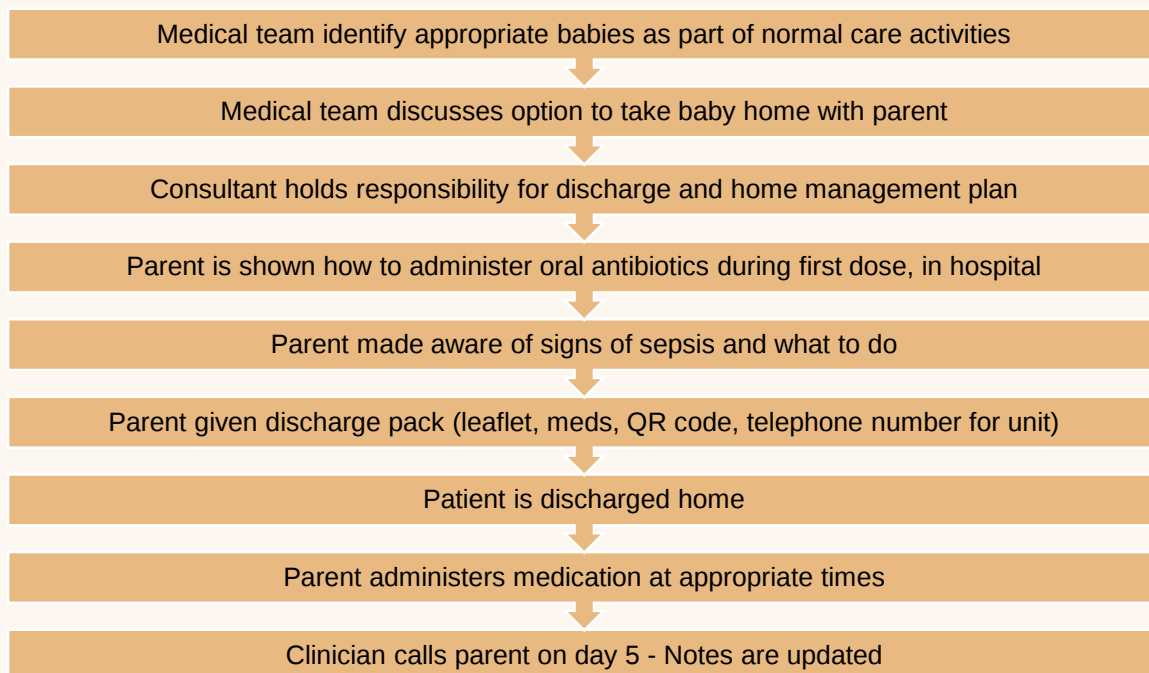


Figure 5. NOAH pathway

3.1.2

Who is being offered and who is accepting the NOAH pathway?

In the six months between 3rd June and 3rd December 2024, 139 newborn babies were screened for sepsis at RDUH (Exeter). Of these babies, 93 were discharged after 36 hours of intravenous antibiotics following a low CRP, no ongoing concerns and negative cultures; 46 continued on antibiotics: 19 were retained on the ward to complete a full course of IV antibiotics and 27 babies were put on the NOAH pathway to complete their course of antibiotics orally, at home (see Appendix A for a breakdown).

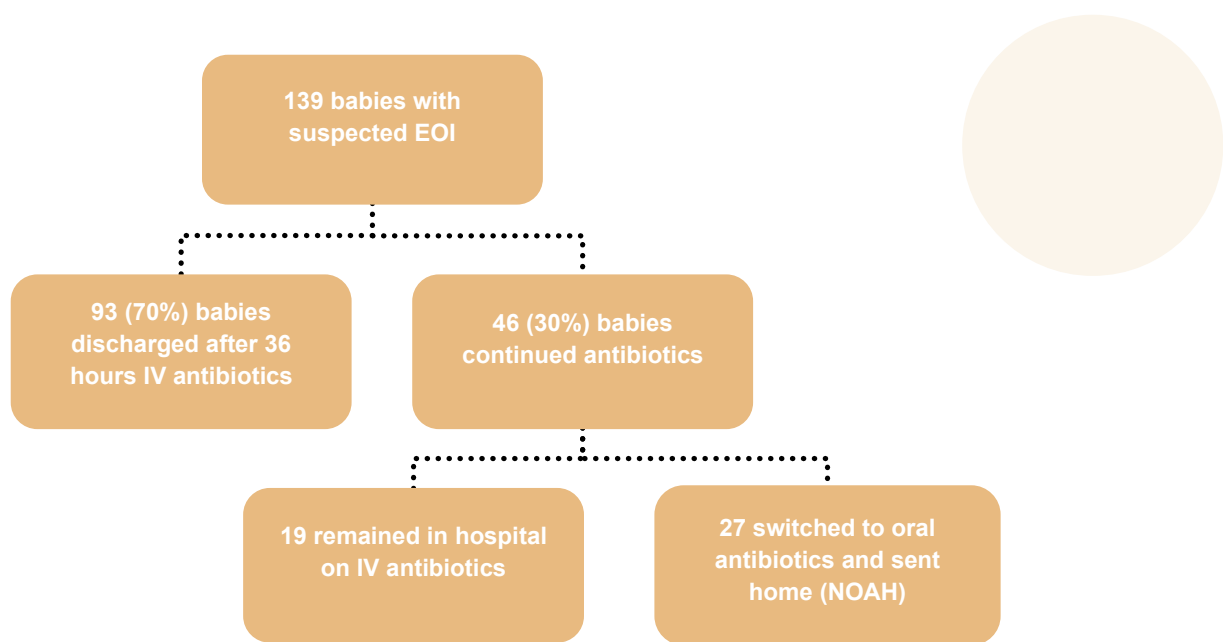


Figure 6. Pathway breakdown for all babies with suspected EOI.

Based on these figures, it is estimated that between 50 and 60 babies would be eligible for the NOAH pathway per year, approximately 1.5% of the Trust's birth rate (3,500 births per year).

The families of all NOAH eligible babies were offered the pathway. A review of the data of the babies who remained on the ward to complete IV antibiotics showed that none would have been eligible for the NOAH pathway. This suggests that all those eligible for the NOAH pathway were supported on the NOAH pathway.

Babies on the pathway had an average birth weight of 3,665g (range 2,699 to 4,780g) and were born between 37- and 42-weeks' gestation (average 39 weeks and 6 days). Average peak CRP was 23 (range 3 to 39) and their last CRP (before discharge) was 12 (range 3 to 23).

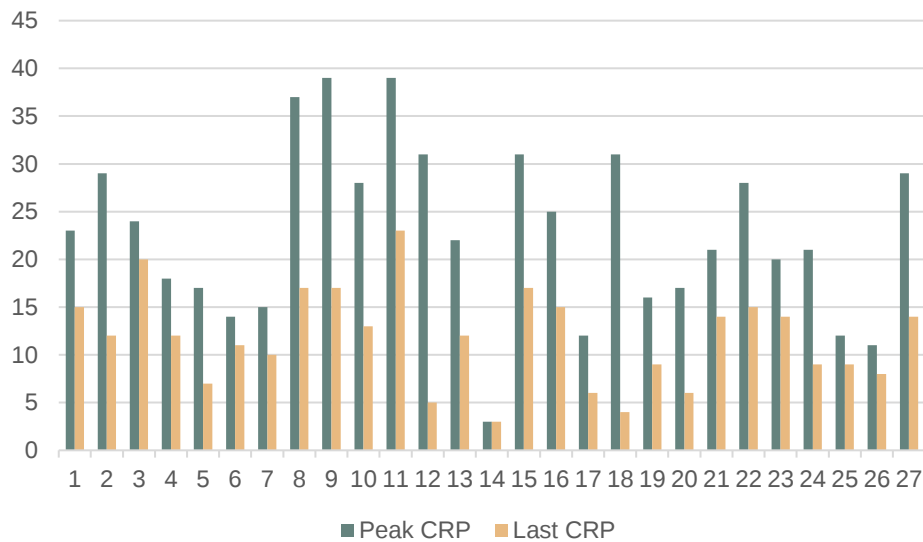


Figure 7. Peak CRP and last recorded CRP levels (Y axis) of each NOAH pathway baby (X axis) before discharge. System data

Examining postcodes shows that babies came from families who lived across Devon and primarily from areas classified as IMD level 4 and above on the Indices of Multiple Deprivation (IMD) deciles (where 1 is most deprived and 10 is least deprived). Only one of the 27 babies (4%) on the NOAH pathway came from a family who lived in the lowest 3 IMD deciles, which is comparable to total proportion of women of childbearing years (15-45) across East Devon, Mid Devon and Exeter (3.4%).

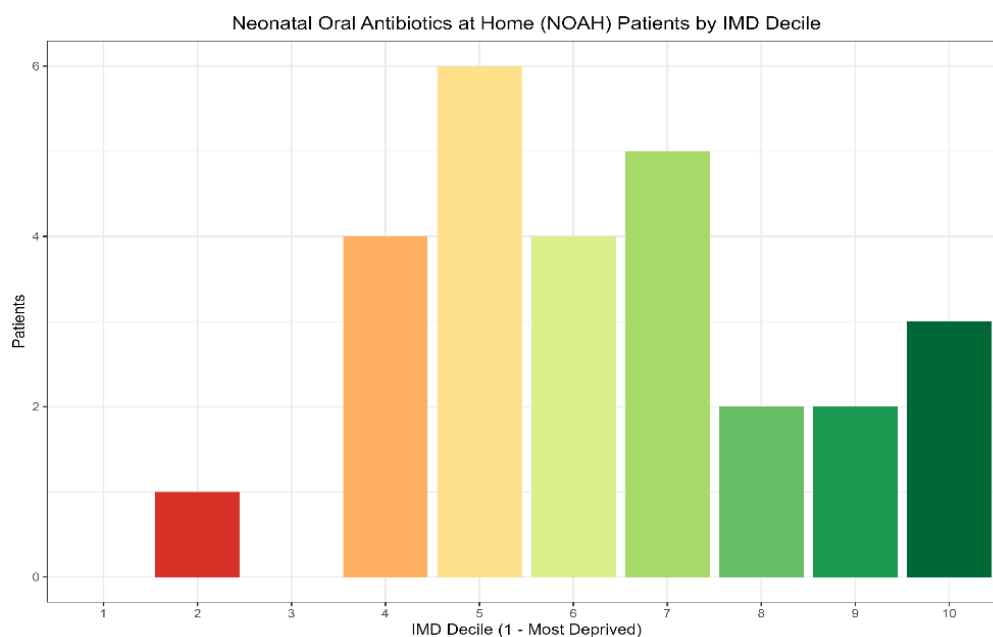


Figure 8 Patients by IMD decile. System data

Families lived on average 27.4km (range 2.6 to 88.6kms) from RDUH (Exeter), from across Devon, demonstrating the breadth of the county and distances patients and their families needed to travel to get to the hospital.

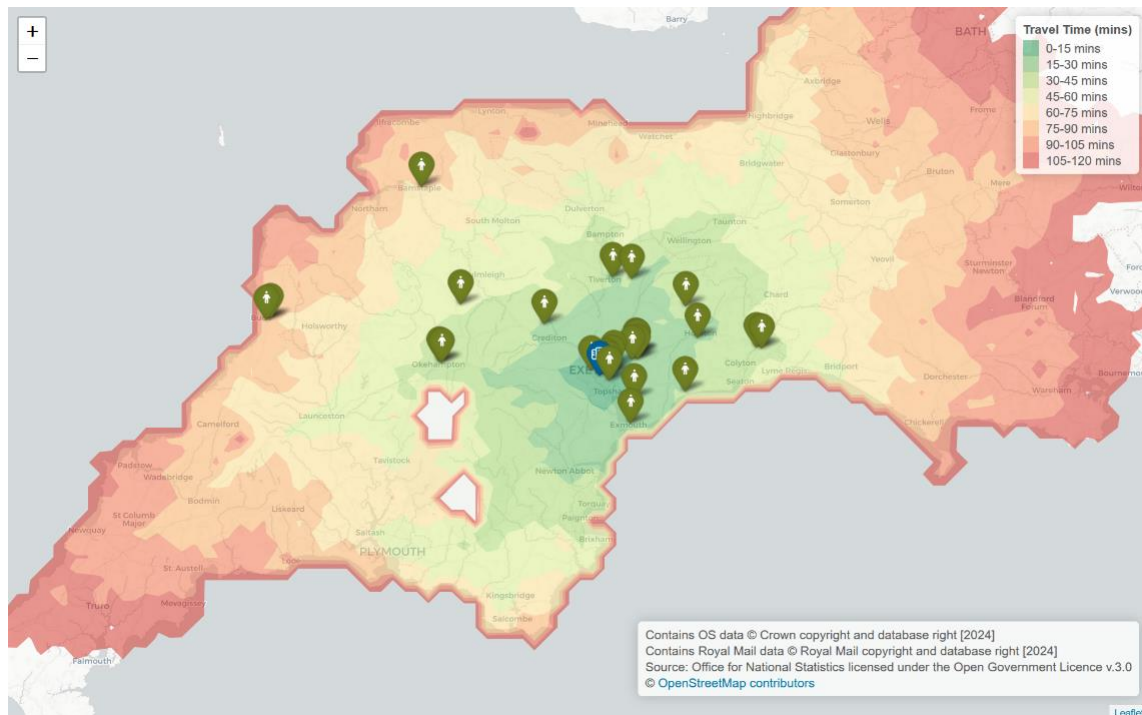


Figure 9. Approximate location of families (green pins) in relation to RDUH (Exeter) (blue pin)².

² White areas are areas network without a road.

3.2 Experience

3.2.1 What is the parent experience of their baby being discharged early with oral antibiotics?



All parents reported feeling “very happy” to leave hospital with their baby on oral antibiotics rather than stay in with their baby on IV antibiotics.

Parents surveyed and interviewed expressed strong satisfaction with their experience of being discharged onto the NOAH pathway. All parents who responded to the survey reported feeling ‘very happy’ to leave hospital with their baby on oral antibiotics rather than stay in with their baby on IV antibiotics.

Relieved that we no longer had to remain in hospital and that our baby was well enough to have his cannula removed and the antibiotics administered orally.

Parent (Survey)

3.2.1.1 Experience of the NOAH pathway while in hospital

All parents who responded to the survey reported being satisfied with the support on the ward and the explanation of how to administer antibiotics to their baby (figure 10). Further, they reported a comprehensive understanding of how to administer the antibiotics (figure 11).

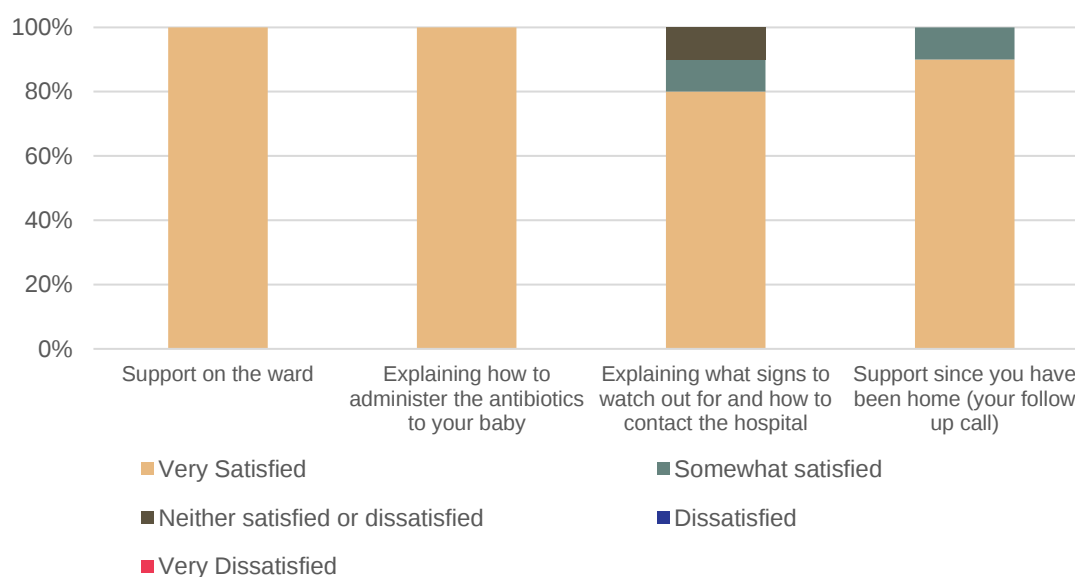


Figure 10. Parent satisfaction with support. Parent Survey.

One parent who was interviewed recalled the instructions they were given:

We were told to do them every eight hours until a specified day. And to try and keep to the schedule within it. And it was 0.85 millilitres each time. And we were given a syringe to do it, and we were shown in the hospital to sort of put it in the side of his mouth when he opened it up, do it little bits at a time to get the syringe down to zero.

Parent 3 (Interview)

Eight out of the ten parents who responded to the survey were satisfied with the explanation for what signs to look out for and how to contact the hospital (figure 7) and reported a comprehensive understanding of what signs to look out for if their baby started to deteriorate and what to do in that situation (figure 11).

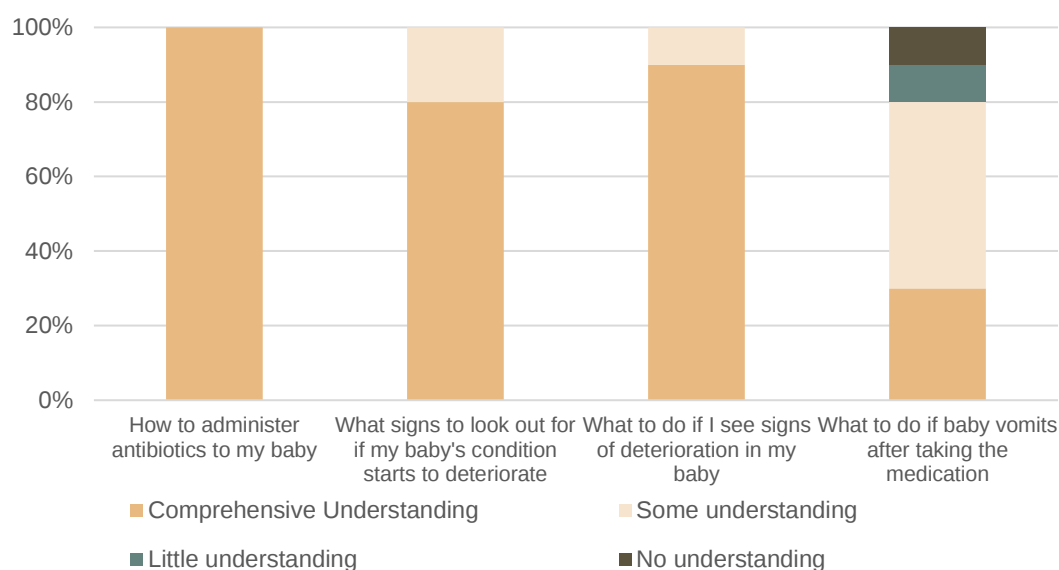


Figure 11. Parent understanding of the pathway. Parent Survey.

Interviewees also noted that they felt they were well informed:

We were definitely like given that information on when to bring him back, and if we were worried, if he dropped feeds, if he was lethargic, and things like that.

Parent 2 (Interview)

Fewer parents (30%) however, reported having a comprehensive understanding of what to do if their child vomited after taking the antibiotics (figure 11) suggesting further or more consistent advice could be given around this area.

At that point? Probably, yeah (had all the information I needed). But now maybe in retrospect, I don't really know what I should have done if she had, spit up.

Parent 1 (Interview)

3.2.1.2

Experience of the NOAH pathway whilst at home

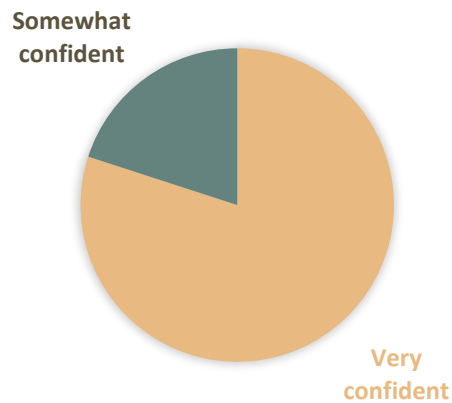


Figure 12. Parent confidence to manage their baby's treatment at home. Parent Survey.

All parents surveyed felt confident to manage their baby's antibiotics at home. All parents also reported feeling in control of their baby's treatment at home (Figure 12). All parents who responded to the survey administered the full course of antibiotics and reported that their baby tolerated them well.

It was quite easy with her actually because she quite liked the taste of them. We never had any issues of giving them to her. It was quite easy to just squirt it in her mouth and she would just swallow it straight away.

Parent 1 (Interview)

Two parents (8% of the 25 who had a follow up call), when asked during the follow up call, reported that they had had some difficulty giving the antibiotics (one noted that their child had spit up some of the dose).

All parents who filled out the survey reported being satisfied with the support at home (figure 10). Interviews of three parents offered further insight into their experience of taking their babies home on oral antibiotics. All reported positive experiences of being at home.

Oh, it was much better. I mean, I'm so glad they like let us go home from the ward because, I mean, I was so ready to go home. So it was like night and day between being in hospital and being at home with her

Parent 1 (Interview)

The parents who were interviewed talked about how they scheduled the antibiotics, one stating they were already recording lots of information about feeds and nappies and the antibiotic times aligned with that. One recalled being on antibiotics themselves and taking their medication together.

And yeah, it was absolutely fine. He took it like a dream. He just didn't make a fuss at all. Just happily took it. And we found because we were already recording all of his feeds and nappies and stuff in the early days, it was quite easy to remember to record when he was having them We managed to keep track of when he had them. And, yeah, it was, it was actually fine. It was really easy.

Parent 2 (interview)

I was also on antibiotics as well, at the same time so, so we had our antibiotics at the same time.

Parent 1 (interview)

It was good. The eight hours seemed sufficient time enough to sort of get him down to sleep, especially the sort of overnight one, because we could do it about 10 o'clock in the evening and then not again until six o'clock the following morning.

Parent 3 (interview)

Patient records highlighted that in the first few weeks, parents of two babies did not receive the follow up call (despite attempts being made). The lead clinician noted that this was a problem early on as they didn't have a set routine for who called and when.

We had decided that the baby should have a follow up phone call on day five or day 4-5. We had left it a bit flexible because we found that we couldn't make that appointment at a fixed time because of clinical pressures and the fact that we wouldn't really want to be making those phone calls over the weekend when it could be really busy. So that was a bit variable, and we left that sort of at the discretion of the medical team and what was happening was that the junior doctors were doing the calls right at the end of the day and it was being left to the most junior person in the team... It would be the last job of the day and they were trying to ring parents at 6-7 in the evening and parents weren't picking up and so that that was a problem. We overcame that by allocating that task to the middle grade doctor and stipulating that that phone call should be done as part of their ward round, so that it should be done ideally around lunchtime by that senior person and that just really keeps those babies visible and kept that medical oversight.

NOAH Lead Consultant (interview)

One parent noted that the follow up call was reassuring for them to know that everything was ok.

I thought it was good because a neonatal call just to check everything was going okay, and if there had been any problems, I could have come back to the hospital.

Parent 3 (interview)

Two parents responded to the survey question asking how they could have felt better supported did suggest that they would have appreciated a secondary phone call or an additional way to reassure them that their baby was better.

A secondary phone call after the antibiotics had finished to ensure there were no worries or anxieties around baby's progress.

Parent (survey)

I felt a little unsure to know that it was all sorted/treated, no additional tests after antibiotics finished. This made me a little more anxious looking out for signs once they were completed.

Parent (survey)

Overall, parents report being relieved to be able to take their baby home and feel happy and informed about what to do with their medication when they are there.

3.2.2

What are the medical team views about discharging babies and managing the risk of babies continuing their antibiotic treatment at home?



Overall, 97% of staff felt confident that babies who meet the criteria for the pathway are safe to go home on oral antibiotics and supported the

3.2.2.1

Experience of Implementation

Staff were asked about various factors concerning the implementation of the new pathway and the vast majority reported a positive experience.

Staff reported being made aware of the new pathway changes before implementation (90%), that they understood what the pathway was trying to achieve (100%) and that they supported the implementation of the NOAH pathway (97%). Further, staff felt comfortable knowing that babies were on the pathway (93%) and confident that they could perform their roles in sending babies home (93%, Figure 13).

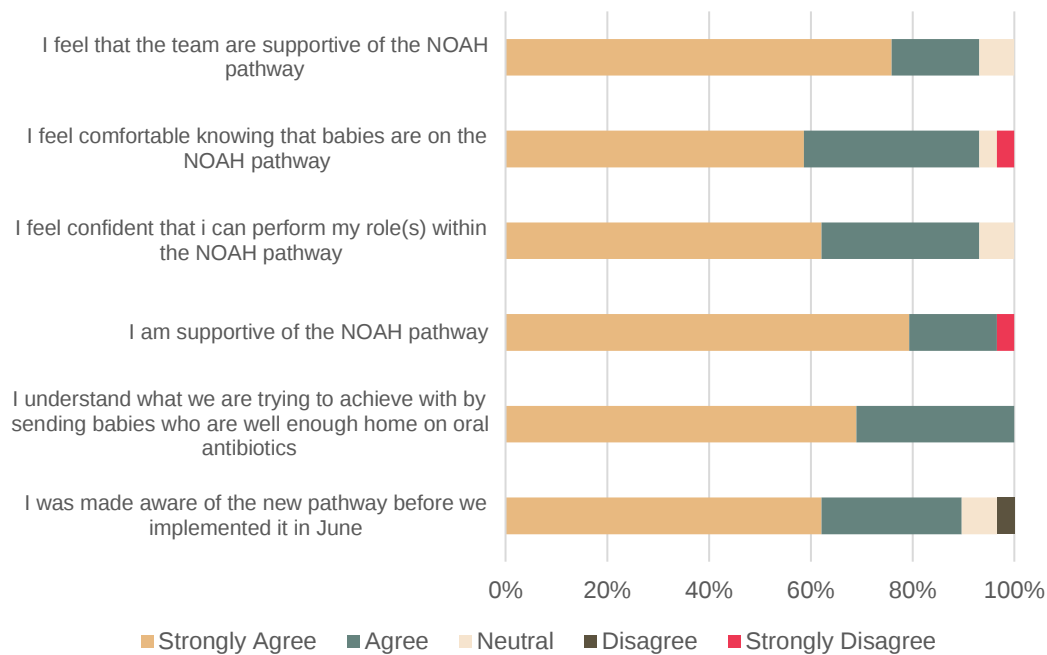


Figure 13. Staff views of the NOAH pathway. Staff Survey.

The clinical lead echoed this positivity when asked how staff felt about the implementation of the NOAH pathway:

Excitement mostly, people were keen for the project.

Parent NOAH Lead Consultant (interview)

When staff were asked about their interactions with parents, they largely reported having positive interactions, and that parents were very happy to go home on the pathway.

Positive experience, parents keen to go home sooner than they would have previously. Easy to have the conversation, backed up with written info.

Neonatal QIS (Qualified in Speciality) Nurse

I felt very confident in talking to parents about NOAH. Parents have been positive about NOAH.

Neonatal QIS (Qualified in Speciality) Nurse

A small number of staff noted some concerns they had encountered from parents:

- ✂ one person noted that a parent had concerns about the impact of oral antibiotics over intravenous antibiotics;
- ✂ one person noted that a parent had expressed concerns about gut flora;
- ✂ one person noted that some parents were “unclear about identifying signs of sepsis”; and,
- ✂ one member of staff noted an issue with a discrepancy between the discharge notes and the medication bottles in terms of dosage and end date (which they corrected).

Despite these concerns, when staff were asked how parents feel about taking their baby home on antibiotics, all those who answered the free text question stated that parents felt happy to take their baby home.

Parents I have spoken to have been keen to take their baby home on oral antibiotics.

Advanced Neonatal Nurse Practitioner

They were all extremely relieved to get out of hospital as soon as possible and felt well supported to look out for signs of their baby being unwell.

Tier 1 Doctor

All but one member of staff reported being supportive of the change in pathway for some babies on antibiotics. One member of staff still had concerns about switching from intravenous to oral antibiotics, suggesting they had not been made aware of or did not trust the existing evidence.

3.3 Impact



97% of staff felt that the NOAH pathway has a positive impact on babies, families, and the hospital.

3.3.1 What is the impact of the NOAH pathway on parents?

The implementation of the NOAH pathway leads to parents taking their babies home on oral antibiotics, rather than staying in hospital for further time to finish the full dose of IV antibiotics. Parents consistently expressed relief and positivity for the opportunity to leave hospital early. The lead consultant described some of the likely reasons for this:

If a baby required five days of antibiotics, they had to be in hospital for the whole duration of that course, and that involves the mother staying as well. So separation from other any other children at home or from her normal support systems. This could impact on breastfeeding: we could speculate. In some settings, it involves separation of the mother and baby. If the baby has to be taken away from the mother to have cannulas or to have antibiotic doses, that depends on the local setup, that certainly is the case where I work.

NOAH Lead Consultant (interview)

All but one member of staff who responded to the survey felt the introduction of the pathway would have a positive impact on babies, families and the system (figure 14).

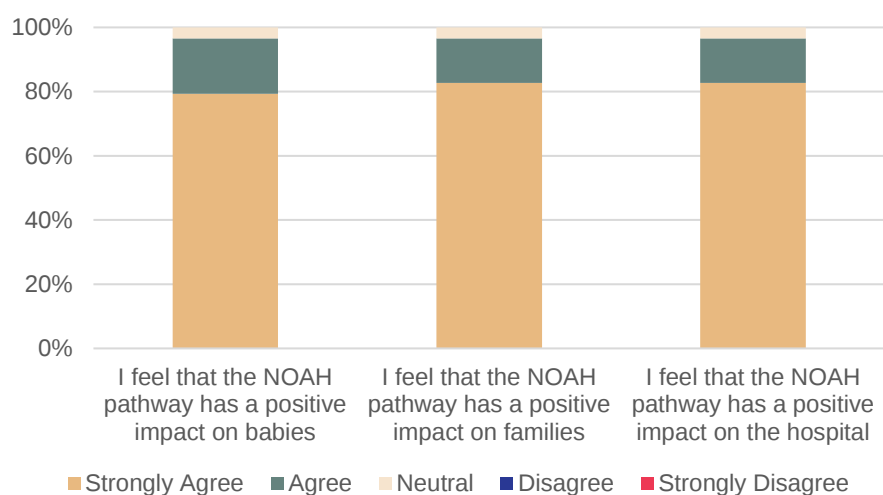


Figure 14. Staff feelings of impact of NOAH pathway. Staff survey.

Parents agreed, reporting positive impact for them and their family.

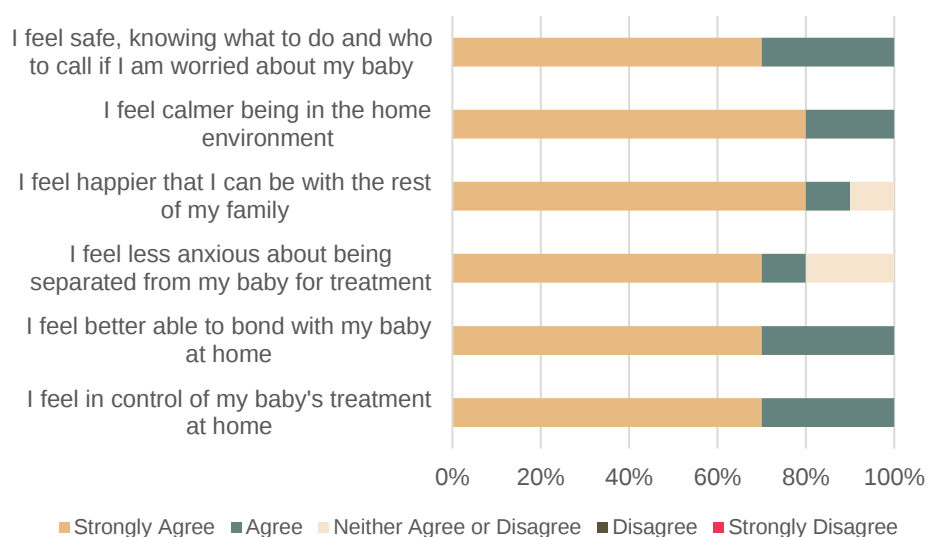


Figure 15. Parents feelings about the impact of the NOAH pathway. Parent Survey.

3.3.1.1 Breastfeeding

The vast majority of parents on the NOAH pathway were breastfeeding or expressing breast milk for their babies (76% breastfeeding/expressing breast milk, 16% combi feeding breast and formula, and 8% formula feeding).

In two of the three interviews, parents spoke of the benefits of being at home to support them to establish breastfeeding.

I mean, it was, it was really difficult, because I was there for five days, and obviously my husband couldn't stay and I really struggled with breastfeeding in the beginning, my milk didn't actually come in until the day I left the hospital, so about five days in... I think being able to come home and kind of get going with the breastfeeding, because it was quite kind of difficult in hospital, because I didn't have, like, a comfortable chair to do it in, and I couldn't really get her to latch properly while I was sat in bed. So being able to come home and, you know, have my comfortable chair to sit in where I could kind of get her to latch better. That was definitely helpful in terms of the breastfeeding.

Parent 1 (Interview)

...especially with like breastfeeding and like your milk coming in, and the emotions and needing all those good hormones to get the breastfeeding journey started. I think being at home definitely was really helpful for that..

Parent 2 (Interview)

3.3.1.2

Family support

Nine of the ten parents who responded to the survey reported feeling happier that they could be with the rest of their family at home (Figure 15). Parents noted the benefits of being at home with their partner able to play a much bigger role, and family able to visit and offer support.

So it was really big struggle, actually, especially during the night time, because my husband can't be there, and being in the bays as well with other people, you know, one baby stops crying, the next one starts crying. So I didn't really get much sleep. So it was quite stressful.

Parent 1 (Interview)

And yeah, just being able to have a bit more family support as well, because obviously that visiting hours are limited on the neonatal unit, but at home, we can have people come and go and drop things over, and that was definitely really helpful. And just being in our own bed, and having all of our own stuff, and your own shower.

Parent 2 (interview)

We were glad to get home at the end of it, because dad could then help with looking after [baby].

Parent 3 (Interview)

It's a more relaxed environment not having the sort of sock on his arm, it makes it easier to change outfits as well when needed, and just getting that extra support from partner as well as other family members

Parent 3 (Interview)

3.3.1.3

Ability to bond with their child

100% of parents surveyed agreed that they felt better able to bond with their baby at home (Figure 15). Parents put this down to home being a calmer and less stressful environment.

I think it was obviously our own home environment less stressful for me and [father] that we could sort of settle into our home environment, which obviously affects how [baby] is doing and coping. And all of those love hormones, like the oxytocin and the relaxed feeling that you get when you're at home, and so important in those early days and weeks with a baby, that I think being at home definitely made that easier

Parent 2 (interview)

We were incredibly happy and relieved to be able to take our baby home, and recovery and bonding as a family worked much better at home.

Parent 1 (survey)

I mean, I felt like, when I was in the hospital, I wasn't really able to bond with her at all, to be honest. I really struggled with that while I was in. Once I got home, I definitely started to bond with her a lot better.

Parent 1 (interview)

3.3.1.4

Levels of anxiety around separation

While not relevant to all Trusts, at RDUH (Exeter), babies often need to be taken away from their parents for cannulations and for IV medication to be given. Eight of the ten parents who responded to the survey felt less anxious about being separated from their baby for treatment (Figure 15) once on the NOAH pathway.

Interestingly, one parent reported welcoming the separations that were required at night while the baby was on IV antibiotics as they enabled her to “get some sleep”.

3.3.1.5

Mental health

All parents reported feeling calmer in the home environment (Figure 15). Parents reported how difficult it was to be in hospital by themselves with a new baby.

Having to stay in the hospital without my partner was really hard - both from a physical and emotional perspective. It felt much more natural to be new parents together than being the sole caretaker of a newborn.

Parent (survey)

One parent noted that being able to go home from hospital also has a positive impact on their partner's mental health.

[Father] struggled to get into hospital because of anxiety. So we did have family helping bring him in, but he was really looking forward, and took over nappy changes and a bit of [baby]'s care when we got home. So that was really helpful.

Parent (interview)

3.3.1.6

Travel

The survey asked parents how many households routinely visited them while they were in hospital, 70% of parents reported daily visits from one household while they were in hospital, 20% reported daily visits from two households and 10% reported daily visits from three households. Extrapolating this to the total number of babies supported (n=27 in six months, 54 per year) and taking the average number of days in hospital saved (2.7 days, rounded to 3 visiting sessions) suggests that the pathway would save around 227 journeys to and 227 journeys back from the hospital, and save families and friends the cost of 227 parking sessions (£2.80 per 3 hour session, totalling a saving of £635 for the families and friends of those on the pathway).

The average distance between a parent's home and the hospital was 27.4km (range 2.6 to 88.6kms making it unlikely that any visitors walked to the hospital). This suggests an approximate saving of 12,432 km travelled for visiting (if annualised)³.

3.3.2

What is the impact of the NOAH pathway on system resources?



The introduction of the NOAH pathway saved an average of 2.7 days of a hospital stay per patient.

³ These figures assume that visitors came from a similar location to the person they are visiting.

3.3.2.1 Length of stay

One of the main benefits of introducing the NOAH pathway to the ward is that it means babies can go home earlier and therefore reduce their length of stay in hospital. Patient records shows that the average length of stay in hospital on the neonatal ward for a NOAH pathway baby was 2.3 days. Prior to the NOAH pathway, all these babies would have received five days of IV antibiotics, on the ward, in hospital.

So babies aren't in the hospital anymore and that's probably the biggest benefit. So those babies would have previously been mostly transitional care babies. They would have been rooming in with their mother on transitional care and the way that affects the staffing in transitional care varies from unit to unit. But for us, those babies are cared for by a member of neonatal staff. And with the NOAH pathway, those babies are at home... They're not in a bed and they're not in that nurse's workload. And so that's really the main benefit that we can see is that babies aren't in hospital. And I think that's a good thing.... And obviously the cost and the impact on the hospital of having those beds full with babies who are otherwise well, there's this cohort is well babies other than that sort of suspicion they might have infection, but clinically they're well and they're in a bed.

NOAH Lead Consultant (interview)

The introduction of the NOAH pathway has led to baby and parent avoiding an average of 2.7 days of hospital stay each (145 days annualised). Assuming an average cost of £452 per day⁴, this is an annual cost avoidance of around £65,540 but more importantly, this represents beds that are free and staff that are available for babies who need more support.

The NOAH pathway involves one follow up call from a consultant as part of the ward rounds on day 5-7 following discharge, in practice this equates to around one call per week. If these babies remained in hospital, they would require daily review from a member of the medical team and nursing activity around medication administration.

⁴ 2022/23 Tariff Payment System: Non-mandatory guide and benchmark prices. Neonatal critical care, special care, with external carer.

3.3.2.2

Readmissions

Looking at the retrospective audit of all babies across 2022 who would have been eligible for the NOAH pathway but remained in hospital to complete at least five days on intravenous antibiotics, we can see that eight out of the 50 babies (16%) re-presented within 28 days of life. Of the 27 babies on the NOAH pathway, 24 were more than 28 days old prior to the end of the pilot time-period, meaning that only these 24 babies are included in this part of the evaluation. Of these, there were three (13%) unrelated readmissions to hospital within 28 days. **This suggests that the pilot did not demonstrate any increase in readmission or re-infection among babies switched to oral antibiotics within the first 28 days of life.**

3.3.2.3

Medication use

Overall, by moving babies to the NOAH pathway, they will, by default, require antibiotics for an additional 2 days. Previously they would have received intravenous antibiotics for 5 days and now they receive intravenous antibiotics for 36-90 hours (average 55 hours) before being discharged home with oral antibiotics to complete a total of seven days on antibiotics.

However, by switching from IV to oral antibiotics, each baby avoids an average of 1.3 doses of gentamicin. For a five-day course of IV antibiotics, in hospital, babies would receive three doses of gentamicin. Table 1 below shows the number and proportion of babies on the NOAH pathway receiving fewer doses, compared to what they would have received if they had completed five days of IV antibiotics. **Across the six months, 34 doses of gentamicin were avoided by changing the patient pathway.**

Number of doses	Number of babies (%) if stayed in hospital (n=27)	Number of babies (%) on NOAH pathway (n=27)
1	0	8 (30%)
2	0	18 (67%)
3	27 (100%)	1 (4%)

Table 1. Gentamicin use for NOAH babies. System data.

Records of antibiotic usage on the Neonatal Unit (table 2) also show a drop in gentamicin use, as well as a reduction in overall use of intravenous antibiotics. This reflects the introduction of the new NOAH pathway.

	2022	2024
Benzylpenicillin (IV antibiotics)	2.9	2.6
Gentamicin	2.7	2.1

Table 2. Average days of antibiotic given, per patient, 3rd June to 3rd Dec 2022 and 2024. Neonatal Unit Report: Drug Summary (all patients).

All babies on the pathway met the eligibility criteria for the NOAH pathway. Further, the number of babies on the pathway was similar to the number predicted to be on the pathway based on data from previous years. This suggests that it is likely the pathway did not pick up additional babies from other pathways, particularly those who were well enough to be sent home without antibiotics.

Examination of the cost of equipment and medication associated with being on the NOAH pathway versus the same babies remaining in hospital for the full 5-day course of antibiotics (see figure 16 below) shows a difference in cost from £30.82 per baby (NOAH) to £49.41 (5-days IV). This equates to a total cost avoided (assuming 54 babies per year) of around £1,000 per year.

3.3.3 What is the impact of the NOAH pathway on babies?

Feedback showed that a longer hospital stay with more intravenous antibiotics was also difficult for the babies, suggesting the reduced length of stay was also beneficial to them.

Because sometimes the observations, I understand, well, it had to be done, but he didn't seem to like the temperature probe particularly. So it got him a bit unsettled after having the observations and the antibiotics together

Parent 3 (Interview)

3.3.3.1

Use of gentamicin

As stated above, the implementation of the NOAH pathway reduced the use of the broad-spectrum, potentially nephro- and oto-toxic antibiotic gentamicin, from 3 to 1.7 doses per baby. The use of gentamicin increases the babies' risk of developing hearing or balance problems (Schacht et al, 2012) with the risk of problems increasing with increased duration of exposure (Kent et al, 2014).

3.3.3.2

Re-cannulation

A further benefit of switching from intravenous to oral antibiotics that was noted in the feedback was the reduction in the need for re-cannulation, a difficult process that often takes multiple attempts in newborns.

So he got taken away to put the cannula in his arm so he could receive the IV. The doctor who did it was good. He tried two attempts, managed to get some things out on the second one. But then another person was called in to do it in the other hand.

Parent 3 (Interview)

*Just having to put repeat cannulas into a baby.
It's a painful process.*

Consultant (staff survey)

3.3.3.3 Efficacy of treatment



All babies completed their course of antibiotics, with no increase in readmission rates based on similar babies in previous years.

All babies completed their course of antibiotics and the pilot saw no increase in 28-day readmission rates based on a sample of similar babies from a previous year (2022). Although one member of staff remained concerned, all other members of staff felt the switch from intravenous to oral antibiotics for well babies was a safe and effective treatment option.

What the RAIN study suggested is that it is safe to switch babies from IV antibiotics to oral antibiotics for part of their course. So what we have done with NOAH is implemented a different pathway whereby eligible babies can be switched from their intravenous antibiotics to oral antibiotics at 36 to 48 hours and discharge home with those oral antibiotics, which facilitates earlier discharge, avoids cannulation in the babies and was based on the evidence available we believe is safe.... this cohort is well babies other than that sort of suspicion they might have infection, but clinically they're well.

NOAH Lead Consultant (interview)

Although this is based on just six-months of the pathway (and 24 babies with at least four weeks of time passed since discharge), findings support the evidence base to date, that switching well babies from intravenous to oral antibiotics is not detrimental to the baby's recovery.

3.3.4

What are the impacts of the NOAH pathway on factors associated with environmental impact.

The NHS is responsible for around 4.5% of the UK's total carbon emissions and has an ambition to be the first health service to achieve 'Net Zero' by 2040 (for emissions controlled directly by the NHS) and 2045 (for the emissions they can influence). Shifting care outside of the resource and medication intensive in-patient care, for those who are well, may be one way to support this growing ambition.

3.3.4.1

Travel for visitors

Section 3.3.3 shows that the average distances between a parent's home and the hospital was 26.3km, families saved approximately three days of visits and averaged visitors from 1.4 households per day. This suggests an approximate saving of 12,432 km travelled for visiting (accounting for an annualised figure of 54 babies on the pathway and two journeys per visit). The carbon equivalent saving this equates to (assuming 70% of people travelled in an average sized car and 30% by bus) is around **2,300 kgCO₂e**.

3.3.4.2

Inpatient bed days

The introduction of the NOAH pathway led to a reduction in 2.7 bed days per baby, for those people on the pathway, or 145 days in total, if annualised. The carbon equivalent saving this equates to (based on calculated savings on a low intensity ward) is around **5,500 kgCO₂e**⁵.

3.3.4.3

Medication and equipment

The shift from hospital IV to home oral antibiotics results in fewer doses of IV antibiotics, resulting in reduced use (and disposal) of the equipment required to deliver the medication. The figure below shows the reduction in units of equipment associated with an annual total of 54 babies making the switch.

⁵ Source of unit savings for carbon savings: *Sustainable Development Unit (2015). Care pathways guidance on appraising sustainability.*

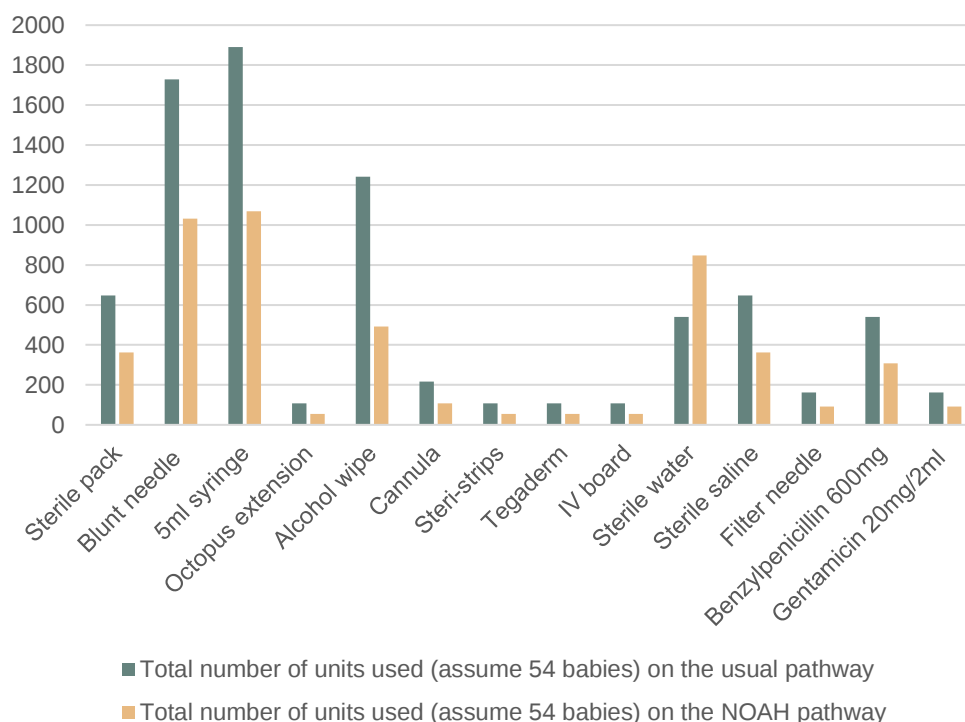


Figure 16. Units of equipment used for babies on the NOAH pathway compared to units used if not on the NOAH pathway. Trust data.

In terms of carbon reductions, these changes in resource use result in a reduction from 19.64kgCO₂e to 11.68kgCO₂e per baby. Assuming an annual throughput of 54 babies, this equates to a saving of **430kgCO₂e per year**.

Overall, the environmental impact of switching well babies from IV in hospital to oral antibiotics at home has resulted in a saving of approximately 8,230kg CO₂. This is the equivalent to the carbon offsetting of planting between 255 and 380 trees.

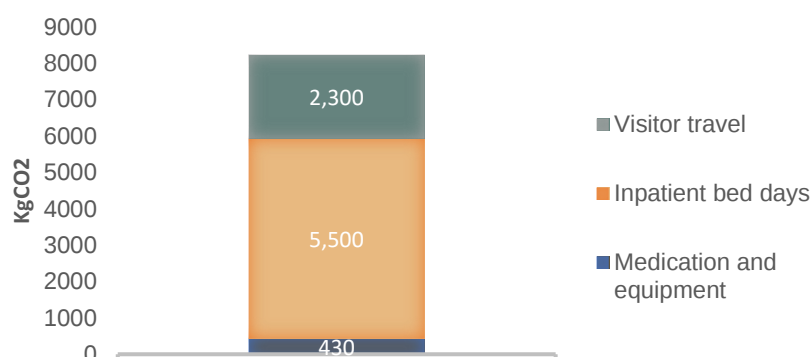


Figure 16. Total annual carbon equivalent savings for the NOAH pathway. Trust data and [UK Government GHG Conversion factors for company reporting and Greener NHS emissions factors 2020/21]

3.4

What can be learned to support future delivery and spread of the NOAH pathway?

3.4.1

Learning about set up of the NOAH pilot

It's not a huge deviation in practice for the nursing staff because they would often teach how to give oral antibiotics... But we did put in some reminders. So, in our handovers we discussed with the medical team [about] this new pathway coming into place and just checked that everyone was on board, made sure that the team knew when they had to do the follow up phone calls... So yes, it was more kind of making sure the team are on board and that if anyone had questions, they needed to ask and making sure there was consultant leadership from the service consultant.

NOAH Lead Consultant (interview)

3.4.2

Learning about implementation

The lead consultant for the programme noted that there were some initial practicalities that needed to be ironed out but that, by working with the team and key stakeholders, they found solutions to the problems.

[there was] some apprehension about the phone calls being some additional work for some of the team... There was some concern from the management side about pathways for babies being reviewed who'd been home, because we can't re accept babies to the neonate unit for infection control reasons... And there was a lot of the conversation was about how these babies would be seen again if they became unwell during their course of antibiotics.

NOAH Lead Consultant (interview)

3.4.3

Conditions for success

Feedback from staff and parents around what worked well and less well alongside reported barriers and facilitators to implementation and delivery offer insight into some likely conditions for success when considering the spread of the NOAH pathway:

Strong leadership to drive the change forward

Good education and presentation of evidence base prior to coming into action.

Tier 2 doctor (staff survey)

Delivered to staff well and good communication.

QIS Nurse (staff survey)

The fantastic organisation & enthusiastic education about it has promoted a positive roll-out. Using the evidence to help the team understand the positives and describe the potential complications and how they are mitigated by the clear criteria of inclusion / exclusion & safety netting.

Consultant (staff survey)

Teams with a positive attitude towards innovation and strong team culture are likely to be more successful.

The team I work with are fantastic in terms of being open to new ideas and innovation. I think new ideas are given lots of air time, this was given the opportunity to be discussed... several times round for everybody to really have time to consider it and have concerns and... discuss those in the team and I think that was really important to have that... like the psychological safety to have that conversation about doing something differently.

NOAH Lead Consultant (interview)

- 💡 Strong working relationships across key stakeholders, for example between the neonatal ward and the pharmacy, especially given the importance of access to the right medication for discharge.

The strong working relationships with the pharmacist we have locally, I know her very well. We've worked together a lot. We have a good strong relationship of problem-solving and making things happen. So that when the team went to her and said, look, we would like to try this new project. What do you think? How can we do this? She was incredibly helpful and really jumped on board with the project. And I think that "can do" culture really helped.

NOAH Lead Consultant (interview)

Availability of co amox. [oral antibiotics] has been good, even at weekends.

Advanced Neonatal Nurse (staff survey)

- 💡 Including phone calls for those babies who were on day 4 or 5 at home as part of the ward round, by a middle grade Registrar kept babies visible to team and ensured medical oversight but also that calls were more likely to be received (rather than being done by a Junior Doctor in the early evening when parents with young babies may not pick up).

FU calls have been made in timely manner.

Advanced Neonatal Nurse Practitioner (staff survey)

- ☞ **Clear and consistent practice with the identification, management and follow up of babies on the pathway was also vital to ensure the safety of babies.**

So [babies] would be identified as part of routine care by the medical team doing the ward round, seeing that baby every day and in our hospital we have a list for babies who we decide are eligible and will be going on that pathway, and then they remain on that list until they complete their course of antibiotics, and that's to ensure that they get the follow up and that the process is followed properly.

NOAH Lead Consultant (interview)

- ☞ **Administering the first oral dose of antibiotics in the hospital was seen as useful for the parents and staff as not only was it an opportunity to demonstrate how to administer the antibiotics but also to allow staff and parents to see how the baby reacted to the oral medication.**

She had oral antibiotic whilst at the hospital - this was a crucial step that assured me that my baby tolerates the antibiotic - there was no fuss or spitting, and she remained content afterwards.

Parent (survey)

- ☞ **As the evaluation found that few parents (30%) reported having a comprehensive understanding of what to do if their child vomited after taking the antibiotics (figure 11), an additional section was added to the patient leaflet to address this question.**

Conclusion

The aim of this evaluation was to establish the efficacy, acceptability and feasibility of implementing the NOAH pathway within the neonatal patient pathway, in the UK.

4.1 Effectiveness

Although a relatively small pilot, in one acute Trust in the UK, findings are consistent with existing evidence that suggests several benefits of the NOAH strategy:

4.1.1 Reduced Hospitalization

Multiple studies conclude that switching to oral antibiotics in clinically stable neonates significantly shortens hospital stays, with no increase in adverse events or treatment failure (Keij, 2019; Carlsen, 2024; Gyllensvärd, 2020). RDUH (Exeter) saw a reduction of 2.7 days in hospital per patient.

4.1.2 Non-Inferiority

The research evidence indicates that, in this context, oral antibiotics are non-inferior to intravenous antibiotics. Both groups had similar reinfection rates and adverse events, suggesting that oral antibiotics provide an equally effective alternative to IV therapy (Keij et al., 2019; Carlsen et al., 2024). This pilot showed similar results with no difference in readmission rates for the pilot sample compared to a similar sample of patients from a previous year, and crucially with no evidence of readmission for infection within the first 28 days of life.

4.1.3 Cost-Effective

By reducing hospital stays, the NOAH approach is consistent with studies and lowers healthcare costs while ensuring that neonates continue their treatment effectively (Gyllensvärd et al., 2020). With the reduction in stay on the neonatal transitional care ward, this pilot demonstrated the ability to save a total annualised cost equivalence of £65,540.

Examination of the cost of equipment and medication associated with being on the NOAH pathway versus remaining in hospital for the full 5-day course of antibiotics suggests a further saving of around £1,000 per year to the Trust.

4.1.4

Improved Family Bonding

Discharging neonates on oral antibiotics avoids separating families and allows parents to care for their baby in their own home, which can improve the neonatal experience and support family health and well-being (Carlsen et al., 2024). Parents from the NOAH pathway pilot reported positive experiences of being able to take their babies home and the benefits of the calm, home environment on bonding and breastfeeding.

4.1.5

Positive Environmental Impact

Switching neonates from intravenous to oral antibiotics showed notable and positive environmental implications: the reduced length of stay led to reduced carbon emissions associated with the stay and travel emissions for visitors; there was a reduction in the use of medical equipment required to prepare and administer the IV antibiotics and a reduction in the delivery of gentamicin.

Overall, the implication of implementing the NOAH pathway for one year is estimated to have saved around 8,230kgCO₂e. The equivalent saving as if planting 255 to 380 trees.

4.2

Acceptability

Both survey and interview data suggest a high level of acceptability of the model from both parents and staff, who show enthusiasm and support for the pathway and satisfaction with their experience. Both parents and staff understood their roles and felt confident to manage the baby at home. Parents reported feeling confident to administer medication and staff were comfortable having babies on the pathway.

4.3

Overall Feasibility

The NOAH pathway was created for term babies who are well following 36 hours of IV antibiotics (peak CRP no higher than 50 and falling, no positive blood culture or CSF (Cerebrospinal Fluid) culture)) but in whom there are ongoing concerns about infection. Evidence from patient records, surveys and interviews demonstrated that the appropriate babies were identified for the pathway and that the babies on the pathway achieved positive results. The pilot reached the number of babies expected, within the timeframe, suggesting a potential annual reach of around 54 babies.

4.4

Learning

The pilot unearthed some early learning that has supported the sustainability of the implementation, most notably about the embedding of follow up calls into practice, and the requirement of consistent communication about the pathway and its evidence while implementing, to secure buy-in from across the team. Learning through the evaluation also informed the development of the patient leaflet to include information about what to do if your child vomits following administration of oral antibiotics.

4.5

The evidence base

More and longer-term evidence is now needed surrounding the use of oral antibiotics in neonates, particularly regarding antimicrobial resistance and the impact on the neonatal gut microbiome. Additionally, while current studies suggest safety in stable neonates, the full impact of outpatient follow-up protocols and monitoring remains uncertain. The approach's generalisability across various healthcare settings, especially those with different resource levels, also requires further exploration, as well as examination of implementation with families facing health inequalities. Finally, more research is needed to establish optimal criteria for oral antibiotic use in this population.

Overall, this evaluation supports existing evidence highlighting the benefits of switching well babies with suspected early onset infection from intravenous to oral antibiotics, demonstrates evidence of a strong implementation model and highlights the positive parent, baby and staff experience of the NOAH pathway.

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Appendices

Appendix A: Breakdown of babies screened for suspected EOI

139 babies screened for sepsis in Exeter June 2024 – end November 2024

93 babies stopped antibiotics at 36 hours due to a negative screen:

3 who met criteria for oral switch, but had treatment stopped instead

- ☞ CRP peak 14, negative culture, remained well throughout
- ☞ CRP peak 12, negative culture, remained well throughout
- ☞ CRP peak 12, negative culture, remained well throughout

46 infants who continued antibiotics:

- **2 who completed 14 days of IV antibiotics**

- ☞ CRP >50, suspicious CSF cell count
- ☞ CRP >50 with positive blood culture

- **2 who completed 10 days of IV antibiotics**

- ☞ CRP <50, but unable to obtain CSF sample following meningism concerns
- ☞ CRP >50, negative CSF. Received 10 days rather than 5

- **2 who completed 7 days of IV antibiotics**

- ☞ CRP <50, but required additional period on CPAP for respiratory support
- ☞ CRP >50, and intubated for PPHN

- **11 who completed 5 days of IV antibiotics**

- ☞ 6x infants: CRP>50, negative cultures
- ☞ CRP <50, but had prolonged period on respiratory support
- ☞ CRP <50, but with clinical seizures

- ☞ CRP <50, but with high white cell count
- ☞ Born in ND, peak CRP 16, requiring ongoing respiratory support
- ☞ CRP <50, negative blood culture, unsuccessful LP. Received 5 rather than 10

- **2 who were switched to oral antibiotics outside the NOAH guideline**

- ☞ Infant treated for umbilical flare with IV Flucloxacillin, later switched to oral
- ☞ Infant treated for EOS, and switched to oral rather than stop or continue IV due to suspicious CXR changes with a low-grade temperature

- **27 who met criteria for oral switch and were sent home on oral antibiotics**