

## INTRODUCTION

Tuberculosis (TB) in children is of importance for a number of reasons:

- the burden of the disease and long treatment courses on young people
- the increased risk of morbidity and mortality than in adults
- the need for specialised care
- the heightened risk of missed or delayed diagnosis
- the link with incidence in children and local transmission

Children develop TB sooner after exposure than adults and rates especially in UK-born children can be used as an indication of transmission in the local community (PHE, 2017)

Previous reports demonstrated that TB rates in children in Yorkshire and the Humber (Y&H) remained static between 2001-2011, with no significant decline over time, and that rates in UK-born children were higher than the national average. These findings formulated the basis for this work, with the aims of investigating:

- 1) Incidence of TB in Y&H in children <15 years 2012 – 2016, including indications of local transmission (such as incidence in UK-born children)
- 2) The factors associated with transmission to children more generally
- 3) The root causes of transmission to children in Y&H and the consideration of a root cause analysis tool to assist this investigation

## METHODS

This piece of work therefore is in 3 parts:

### 1) Epidemiology

An epidemiological review of cases of TB recorded in the Enhanced Tuberculosis System (ETS), a database used by clinicians to record information on TB cases and by Public Health England (PHE) to monitor epidemiology.

### 2) Literature Review

A rapid narrative review of published literature from the last 10 years was undertaken using the following terms:

Child (OR synonyms) AND Factor (OR transmission OR outbreak OR delay OR missed OR root OR risk OR cause OR determinant) AND TB (OR synonyms) AND UK (OR similar countries)

In the following databases:

Pubmed, Web of Science, Google Scholar

### 3) Root Cause Analysis Tool

Using the factors and key issues identified in the literature review, a structure was developed to facilitate the investigation of retro- and prospective cases of TB in children in Y&H

## RESULTS

### Epidemiology of TB in children aged 0-15 years in Y&H in 2012-2016

- 188 children were recorded as being diagnosed with active TB between 2012 – 2016 in Y&H
- The annual rate declined significantly over this time (see Figure 1), although this decline was not uniform across Y&H. Sheffield and Bradford saw the steepest decline in rates during this period.
- Rates in 2014-2016 were not significantly different from the England average
- Over 50% of children were born in the UK, with 0-4 year olds contributing a substantial proportion to these numbers. In addition, rates in children in this age group experienced the slowest decline out of all ages
- The highest number of cases were seen in children of White or Pakistani ethnicities, however the *rate* in Black African children is higher than any other ethnicity and the rate in White children is significantly lower than any other ethnicity
- 90% of children who developed TB live in the most deprived 2 quintiles in the country. <1% live in the least deprived quintile

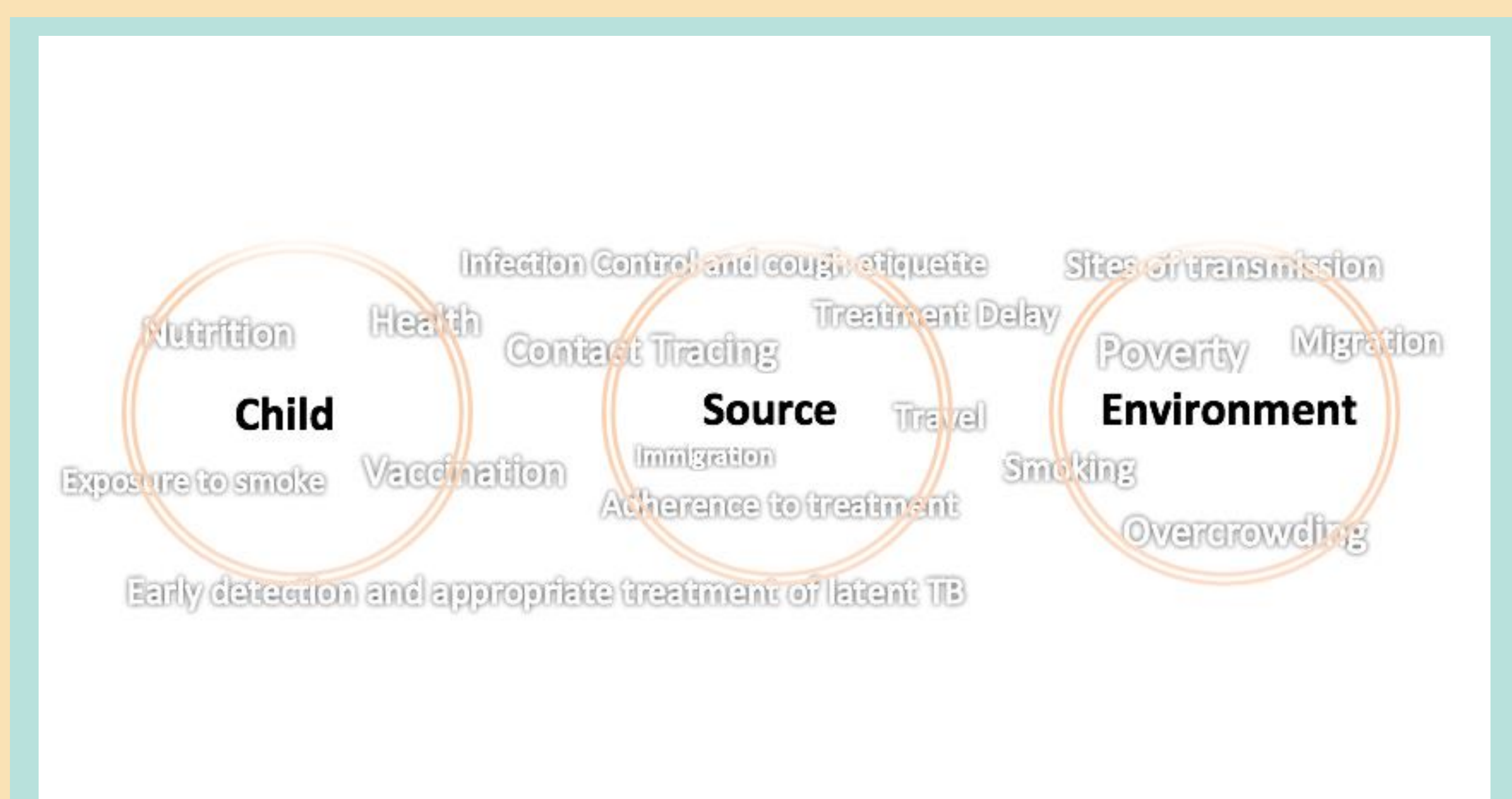


**Figure 1.** TB Rates (per 100,000 children) in 0-15 year olds and in all ages in Yorkshire and the Humber 2012-2016

### Factors associated with TB in children

The literature review revealed the following key points:

- TB transmission must be understood not as a simple exposure → disease model but instead a complex process of exposure → transmission → infection → disease, where each step has different risk and protective factors. The majority of individuals exposed to TB bacteria do not develop infection or disease.
- There are three key points around which these factors coalesce, demonstrated below in figure 2. This picture also illustrates some of the factors that should be considered when investigating the roots of transmission to children. A key point is the identification of the source of infection, which is highlighted by national and international guidance (see for example NICE, 2016, WHO, 2017). This structure provides a framework to collect local intelligence to inform prevention.



**Figure 2.** Risk Factors in developing TB and the three key points around which they can be considered: Child (Host); Source (Index Case) and Environment.

## DISCUSSION

TB in children remains a rare but serious cause of morbidity in this group. Whilst the rate of TB in children in Y&H is decreasing, there remain some important points to note. There is still evidence of local transmission, indicating ongoing risk to both adults and children. In addition, rates are not decreasing uniformly across the board, with variation seen across local authority area, ethnicity, age bracket and by level of deprivation. Deprivation and social adversity remain key issues in this group too, with the additional requirement of considering parent/guardian circumstances as well as their own.

A framework to gathering information on the root causes of transmission to children, especially in those groups and areas that have not seen significant decline in numbers, is therefore appropriate and valuable. Conceptualising risk factors as amalgamating around three key points structures the analysis of transmission across the TB pathway of:

exposure → transmission → infection → disease

TB prevention requires consideration of child (or host), source (or index case) and environmental factors at each point along this pathway.

## CONCLUSIONS

- TB in children is a serious but preventable cause of morbidity in this group. TB in UK-born children is used as an indicator of transmission in the local community.
- TB in children in Y&H is decreasing, but not uniformly across all groups and areas.
- It is necessary to consider the root causes of exposure, transmission, latent infection and active disease in this group in order to understand the cause of variation
- Considering the three key points around which risk factors can be considered is a useful way of conceptualising risk across the TB pathway

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## REFERENCES

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