Statistical Analysis Plan

Level 3: Paediatric Intensive Care

2025

V1.0

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1 Amendments

This Level 3 Paediatric Intensive Care Statistical Analysis Plan (SAP) for the 2025 State of the Nations Report analysis is largely based on the SAP (v1.1 Nov 2024) for the 2024 State of the Nations Report. Updates to this 2025 SAP include:

- General updates to the language throughout to align with the format and language of the results of the analysis (how it is presented in the Interactive Charts and Data).
- References to READ codes replaced with SNOMED CT following the backward compatible move from READ to SNOMED CT in September 2024 (detailed in the State of the Nation Report 2025 Appendices).
- The Townsend Deprivation Index replaces the deprivation quintile of patient's home address, defined by the Children in Low Income Families Local Measure (HMRC, 2014)

The following have been redacted from the plan as they are not applicable to the State of the Nations Report 2025:

- Data Quality: Completion within 3 months of discharge or transfer
- Referral dataset cleaning

2 Introduction

The Paediatric and Intensive Care Audit Network (PICANet) was established in 2001 to record details of the treatment of all critically ill children admitted for care in a designated Level 3 Paediatric Intensive Care Unit (PICU) and currently consists of three main datasets: admissions, transports and referrals. Additionally, information on data quality is also recorded. In 2022, PICANet expanded to collect data on Level 2 high dependency care. This analysis plan relates to data collected from designated Level 3 PICUs only.

The State of the Nations Summary Report presents data on admissions and transports of children and young people to PICU collected in the previous full three calendar years; the 2025 State of the Nations report will therefore analyse and present data from 2022, 2023 and

2024. Data for a three-year period is presented to make sure data is complete, results are comparable and admission numbers are robust.

3 Data

3.1 Datasets

Data manuals for Level 3 PICANet data and information on dataset changes over time can be found online at https://www.picanet.org.uk/data-manuals-and-guidance/.

3.1.1 Admission data

The admissions dataset includes information on all admissions in designated Level 3 PICUs across the United Kingdom and the Republic of Ireland (ROI). Data are collected from admission to discharge with additional data items collected 30 days following discharge such as mortality. Treatment received on the PICU is recorded in terms of daily activities received through the stay in the PICU and SNOMED clinical coding. Daily activities are defined from the Paediatric Critical Care Minimum Data Set (PCCMDS) (1). An admission event should be completed by the admitting unit within two months of the discharge (PCCS L3-702 (2)); prior to the 1st January 2022 the standard was within three months.

3.1.2 Transport data

The transport dataset includes information on all children requiring paediatric intensive care transport by paediatric critical care transport services (PCCTS) or PICU providing the transport for a retrieval / transfer. A transport event is completed by the team providing the transport. The transport could be from: the original admitting hospital to a PICU; between PICUs; or a child requiring paediatric intensive care being moved to a district general hospital, home or a hospice. An event is completed following agreement that PIC transport is required, irrespective of whether the child is transported to another care provider. A record should be submitted to PICANet as soon as possible and no later than two months after a transfer (PCCS Standard T-701 (2)).

Data collection began on 01/01/2012 and was first presented in the annual report in 2014. Prior to 2018 transport events were completed for all children transferred from the original admitting hospital to PICU whereas now we focus on those undertaken by specialised teams as they undertake the majority of transports to PICU.

Transport data items include child demographic information, basic details about the transport team and collection unit, critical incidents during transit, transport times, interventions received by the child both prior to the arrival of the transport team and while the transport team is in attendance (including Paediatric Index of Mortality (PIM) variables), and the outcome of the transport event.

3.1.3 Referral data

The referral dataset includes information on all children referred for Level 3 paediatric intensive care transport and admission. The referrals dataset data collection began on 01/01/2012 and was first presented in the annual report in 2014. We currently don't present Referral data in the annual report as we are reviewing the data capture (aiming to complete in 2025/2026) to improve robustness following significant changes in the way transport teams accept referrals. A referral event is reported to PICANet for all requests for paediatric intensive care transport and all requests for PIC admission where the clinicians agree that the child requires PIC transport and/or a PICU bed. A child may have multiple referral events for the same episode of care, e.g. if it took several attempts to locate them a PICU bed after agreeing they required transport.

3.1.4 Additional external datasets

Child population by ethnic group

Child population by ethnic group is used to calculate the admission rate per 10,000 population by ethnicity for England only. Population data will be obtained via 2021 census data[1].

National child mortality statistics

National child mortality statistics are used to calculate the percentage of child deaths which occur in PICU in the summary report. Data on deaths for 0-15 year olds will be obtained from the following sources:

1. For England and Wales from the Office for National Statistics (ONS)
   Data for 2022, 2023 and 2024 extracted from: Deaths registered in England and

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[1]https://www.ons.gov.uk/peoplepopulationandcommunity/culturalidentity/ethnicity/datasets/ethnicgroupbyageandsexinenglandandwales

Wales[2]

2. For Scotland from the National Records of Scotland (NRS)
   Data for 2022, 2023 and 2024 extracted from: Table DT.03 Deaths, by sex and single year of age, Scotland 1974 to 2024[3]

3. For Northern Ireland from the Northern Ireland Statistics and Research Agency (NISRA)
   Data for 2024 and update on 2022 and 2023 need to be requested from demography@nisra.gov.uk via email.

4. For Republic of Ireland from the Central Statistics Office (CSO)
   Data for 2022, 2023 and 2024 need to be requested from vitalstats@cso.ie via email. 2022, 2023 and 2024 will be year of registration of death.

3.2 Key metrics and key data

The NCAPOP Provider Methodology Manual[4] sets out three types of metrics (four if case ascertainment is included); Outcomes, Process and Structure. PICANet has the following Level 3 key metrics (details of which can be found in the PICANet Key Metric Definitions on the PICANet website at https://www.picanet.org.uk/about/policies/):

- Metric 1a: Case ascertainment
- Metric 1b: Timeliness of data submission
- Metric 2: Retrieval mobilisation times (process)
- Metric 3: Emergency readmission to PICU within 48 hours of discharge (outcome)
- Metric 4: Unplanned extubations (process)
- Metric 5: Risk-adjusted in PICU mortality (outcome)

Numbers of nurses providing care per clinical care bed (a structure measure) was previously a key metric, but was discontinued in 2022 as the data are no longer collected by the audit as requested by NHS England.

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[2]https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/datasets/deathsregisteredinenglandandwalesseriesdrreferencetables
[3]https://www.nrscotland.gov.uk/publications/deaths-time-series-data-2024/
[4] HQIP Provider Methodology Manual available from https://www.hqip.org.uk/about-us/provider-methodology-manual/

Other key data are:

- Palliative care discharge status
- Data items feeding into PIM calculations (required for case-mix adjustment):
    - Elective admission
    - Pupil reaction
    - Mechanical ventilation
    - Absolute values of base excess
    - SBP (systolic blood pressure) at admission
    - $SBP^2/1000$
    - PaO2/FiO2 ratio: $100x\ FIO_2/PaO_2$ (mmHg)[5]
    - Recovery from a bypass cardiac procedure
    - Recovery from a non-bypass cardiac procedure
    - Recovery from a non-cardiac procedure
    - Very high risk diagnosis
    - High risk diagnosis
    - Low risk diagnosis

3.3 Data processing and quality improvement

3.3.1 Database validations

Data is entered onto the PICANet Web via manual data entry or via data import. The 'live' web based data entry system has automatic validations. All validations run: (i) for data import, at time of upload; (ii) for manual data entry: every time a new field is selected and when the event entry is saved.

There are four categories of validation: missing value, warning, error and reject. Further information on validation categories can be found in Appendix A. Some validations allow for manual override by the person entering/checking the data.

3.3.2 Virtual validation visits

Detail of the virtual validation visits can be found in the State of the Nations Report Appendices, see the Methods - Data quality, validation and case ascertain section.

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[5] FIO_2 is the fraction of inspired oxygen at the time of PaO_2, and PaO_2 is the partial pressure of oxygen in the arterial blood

3.4 Management of datasets

Data management is undertaken at the University of Leeds. The Universities of Leeds and Leicester both assess data quality.

3.4.1 Data freeze (soft lock)

A data freeze (soft lock) occurs on the 1st March of each year (or the first working day in March); sites are required to enter information on an event within two months of discharge and therefore all events occurring to 31st December of the previous year should be entered by this point. Prior to 2022, data were expected to be submitted within three months of discharge.

3.4.2 Data cleaning

The main data cleaning process is undertaken annually after data freeze (soft lock) mainly in SQL and Stata by the data manager(s) and statistician(s) analysing the data. See Section 3.5 for details of data cleaning undertaken.

3.4.3 Final data download (data hard lock)

Final data download (data hard lock) will take place following data cleaning and querying (usually in Q2 of the report year). The date of hard lock is agreed within the PICANet team and is dependent on the quality and cleanliness of the data to be included in the report. This means the date of hard lock may change each year due to number of working days, Easter etc. The final dataset will contain events beginning on or before 31st December of the final reporting year which were entered onto the database on or prior to the soft lock of the data.

3.5 Data cleaning and stats checks

3.5.1 Postcode validation

Address details are collected in order to validate postcode. Units in England, Scotland and Wales provide address including postcode; whereas those in the Republic of Ireland provide county and country of residence only and Northern Ireland provide country of residence alone. Validity of postcodes will be checked using the Office for National Statistics (ONS)

Postcode directory for the UK[6]; following this, postcodes not in the directory will be manually reviewed and corrected where possible. PICUs in the Republic of Ireland and Northern Ireland are asked to manually validate country/county of residence.

3.5.2 Patient ID matching review

PICANet employ a probabilistic approach to assigning patient IDs to records, enabling linkage of multiple records for the same patient. The IDs are assigned automatically and an associated confidence score (between 1=low confidence and 3=high confidence) in the matching is provided. Any patient IDs with a confidence score of 1 will be manually reviewed looking at key demographics such as NHS number (or case number, date of birth and sex. Following this review, manual adjustment of patient ID or confidence score is undertaken.

Following this process, instances where a Patient ID has multiple NHS numbers assigned are manually checked and corrected.

De-identified records (such as those for admissions in Northern Ireland or the Republic of Ireland) are given IDs based on perfect matches of case note number, date of birth and sex.

3.5.3 Admissions dataset checks

Overlapping or duplicate admissions

This check can only be conducted once address validation and patient ID matching review has been undertaken. Overlapping admissions <u>within</u> the same unit are identified and manually reviewed. If these appear to be separate patients given same patient ID in error (for example twins) then the patient ID will be amended accordingly referring the multiplicity field as required. Any discrepancies that cannot be resolved by the PICANet team will be sent to the unit. If these appear to be duplicate admissions or overlapping admissions for the same patient, then these will be queried with the unit. Units are asked to resolve such issues via PICANet Web where possible and inform the PICANet team of any alterations.

Events readmitted from theatre as planned admissions within 12 hours

This check can only be conducted once address validation and patient ID matching review has been undertaken. There are some patients who have two or more admission records within 12 hours, e.g. for a patient, a record created before a surgical procedure and then another record created after surgical procedure. These cases are identified within hospitals and are merged centrally by the PICANet team using the first event for patient demographics

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[6] https://geoportal.statistics.gov.uk/datasets/e14b1475ecf74b58804cf667b6740706/about

and PIM data and the last event for discharge and follow-up data; daily activity data is appended as appropriate. This process was undertaken for the 2018 Annual Report to improve consistency in submissions since we became aware that one PICU (Royal Brompton) submitted data differently to all other PICUs. This work was done in SQL and will be repeated for the 2025 State of the Nations report.

Clinical coding

Unknown SNOMED CT codes and SNOMED CT codes falling into the PICANet 'unknown' primary diagnostic category are identified and queried with the unit.

Additional checks

It is known that sometimes a default time (12:00 or 14:00 or similar) is entered for admission, discharge etc. Where deemed relevant, times will be explored on a unit basis to identify any trends and to allow for appropriate assumptions to be made.

The following checks will be performed on the data for the 2025 State of the Nations report. As a minimum, the following will be examined and queried with units where appropriate:

- NHS number (*nhsno*)– where 9s have been provided
- Type of admission (*adtype*) – where unknown
- Source of admission (*sourcead*) – where unknown
- Care area admitted from (*careareaad*) – where unknown and admitted from same or other hospital (as recorded in *sourcead*)
- Main reason for PICU admission (*primreason*) – where unknown
- Surgical procedure (*surgicalprocedure*) – where unknown and main reason for surgical procedure was recovery from surgery
- Evidence available to assess past medical history (*medhistevid*) – where unknown
- Blood gas measured (*bgfirsthr*) – where unknown
- Mechanical ventilation (*mechvent*) – where unknown and continuous positive airway pressure (CPAP) is unknown
- Tracheostomy performed during this admission (*tracheostomy*) – where unknown; and where *tracheostomy* is recorded as performed during the admission ("Yes") but tracheostomy cared for by nursing staff is not recorded in daily activities
- Primary diagnosis (*primarydiagnosis*) – where unknown (unless the accepted code for unknown diagnosis has been used) and child has been discharged prior to data freeze
- Discharged for palliative care (*dispalcare*) – where unknown
- Unplanned extubations – confirmation of events meeting definition and completeness

Country of residence assigned for each event ID for analysis should be checked manually for those admitted to Northern Ireland and the Republic of Ireland via a list sent to units.

3.5.4 Transport data cleaning

As a general rule for the cleaning of transport data, we only identify issues of data quality where the owner of the event is a Paediatric Critical Care Transport Service (PCCTS) or a PICU although in recent years following centralisation of the transport service nearly all events are owned by a PCCTS. All data cleaning should only be undertaken for the most recent year of data.

Duplicate events

Potential duplicates in the transport dataset are identified in the following ways:

1. Two events (or more) with the same patient ID and the transport was accepted at the same date and time.
2. Same patient ID with two or more transports on the same day from the same collection area (investigated to see if they are potentially transfers for short periods of treatments).
3. Two (or more) events where the transport request was received at the same date and time, by the same transport organisation, for two (or more) differing patient IDs that lived within the same IMD score area (note: these could be twins and so manual review is undertaken).

Where possible potential duplicates are investigated further before feedback, e.g. by checking to see if the (local) transport numbers are identical although this hasn't always been possible.

Potential duplicates should be fed back to data owners, with a request for review and probable deletion of one or more events for each suspected duplicate. We encourage data owners to tell us how they have amended the data or why the data is correct if it is not amended. We can, if desired, check that all requests have been dealt with at a later stage.

Transport times and dates

If an event breaches any of the following rules they are identified and the owner of the event will be encouraged to check <u>all</u> dates and times on the transport record to identify the point of the potential error.

- A mobilisation time (difference between time the child was accepted for transport and time when team departed base) which was more than two hours <u>and</u> the transport was non-elective <u>and</u> the event is owned by a PCCTS

- A time to bedside (difference between acceptance for transport and the time of arrival at the collection unit) which was more than six hours <u>and</u> the transport was non-elective <u>and</u> the event is owned by a PCCTS
- A patient journey time which lasted more than three hours and the event was owned by a PCCTS (can be checked for both elective and non-elective events). These are inspected before feedback as there are many journey times that can legitimately last >3 hours.

Where possible the comments field should be investigated, and any other useful variables, to allow acceptance of any instances when the entry is actually correct, e.g. a long mobilisation time due to adverse weather conditions, or a long patient journey time due to a vehicle breakdown or simply a long distance travelled. It should also be investigated if there is an acknowledged delay by the transport team. It is possible to be identified by more than one of these rules at the same time.

Events identified for breaching one of these rules, with no clear reason, are reported back to data owners. They are encouraged to check dates and time and if these are correct, to identify if there should be a reason documented for the delay.

Missing dates and times are not investigated further as this is raised as validation query. However, this should be considered for checking in future years.

3.6 Derivations

3.6.1 Admissions data

Age

Age is calculated as the difference between the date of admission to PICU and the date of birth using the DATEDIFF function in SQL. When date of birth is not provided age is classed as '*unknown*'.

Age in months and age in years are complete months and years respectively, so for example if a child is 14 ½ months old this will be classed as age 14 months or age 1 year. Age in days is similarly complete days.

Bed days (total number)

Bed days looks at how many days children are on a unit for (truncated at the start and end of the reporting period). The total number of *bed days* delivered is calculated as the sum of children in a PICU each day.

Deprivation

Deprivation score is based on the home postcode of the patient of each admission, matched to a Lower Super Output Area (LSOA) and its rating based on the Townsend measure of deprivation (3). Admissions are split into five deprivation categories based on the score of the patient LSOA. LSOA 2021 codes are used for patients residing in England and Wales but the Scottish datazone codes (anything starting with an 'S') are from 2011. There will be an equal number (or as close as possible) of child population in each group, however the number of admissions in each of these categories will vary.

In the 2025 analysis we implement the Townsend measure of deprivation. This replaces the deprivation quintile of patient's home address, defined by the Children in Low Income Families Local Measure (HMRC, 2014)[7]. The change to Townsend in the 2025 report represents a more up-to-date and multi-domain measure, capable of capturing deprivation at small units of geography across the UK (although it only applies for mainland Great Britain as PICANet does not hold detailed spatial information for children living in Northern Ireland or Republic of Ireland).

Emergency readmissions within 48hrs of PICU discharge

Calculated for patients readmitted to the same unit as unplanned admissions (admission type 'Unplanned- following surgery' or 'Unplanned- other') within 48 hours of discharge.

Expected probability of mortality

Expected probability of mortality is estimated using the Paediatric Index of Mortality 3 (PIM3) (4), further details on PIM3 variables can be found in Appendix B. Recalibration on PIM3 data will be required as detailed in Section 3.7.

In previous reports a recalibrated version of the Paediatric Index of Mortality 2 (PIM2) (5) was used (recalibration performed using data to be published in the report). In many tables the expected probability of mortality is presented in groups: <1%, 1-<5%, 5%- <15%, 15-<30% and 30+% to reflect those used by the Australian and New Zealand Intensive Care Society (ANZPICS) (6) for comparability.

Invasive ventilation

A child is said to have received invasive ventilation on any given day if they received either: invasive ventilation via endotracheal tube, invasive ventilation via tracheostomy tube,

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[7] https://www.gov.uk/government/statistics/personal-tax-credits-children-in-low-income-families-local-measure

advanced ventilatory support (jet ventilation) or advanced ventilatory support (oscillatory ventilation) as recorded on the daily interventions (PCCMDS) data.

Length of stay in days

Length of stay is calculated as date of discharge minus date of admission for admissions occurring in the reporting period. Length of stay is not calculated for individuals still on PICU at the time of final data freeze.

Level of activity in PICU

Calculated from the daily activities dataset (PCCMDS) which is a section of the admissions dataset but stored in a different table in the database (the activity dataset). The purpose of the PCCMDS is to provide the basis for payment by results (PbR) through the establishment of healthcare resource groups (HRGs). They were specified to take into account differing levels of activity in PICU, the 2021/22 HRG grouper will be applied to the 2025 State of the Nations Report:

- XB09Z - Enhanced Care
- XB07Z - High Dependency
- XB06Z - High Dependency Advanced
- XB05Z - Intensive Care Basic
- XB04Z - Intensive Care Basic Enhanced
- XB03Z - Intensive Care Advanced
- XB02Z - Intensive Care Advanced Enhanced
- XB01Z - Intensive Care - ECMO / ECLS
- UZ01Z – Unable to group

'Unable to Group' mostly comprises combinations of activities no longer regarded as high dependency, as well as some where problems arise in aspects of the grouper other than activity e.g. Diagnosis.

LSOA

LSOA are derived using the ONS Postcode Directory 2025[8]. Postcodes are each matched to three derived LSOA variables (one for each of the 2001, 2011 and 2021 census geographies).

Non-invasive ventilation

A child is said to have received non-invasive ventilation on any given day if they received non-invasive ventilation as recorded on the daily interventions (PCCMDS) data.

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[8] https://geoportal.statistics.gov.uk/datasets/e14b1475ecf74b58804cf667b6740706/about

Primary diagnosis

The primary diagnosis for the whole admission is categorised into 13 diagnostic groups to enable a simple comparison between organisations. Diagnostic group is assigned using a lookup table developed by Roger Parslow (University of Leeds).

Relative rate of emergency readmission within 48 hours of PICU discharge

The average emergency readmission rate over all units combined calculated. Each PICU's individual emergency readmission rate is then divided by overall rate to give that PICU's relative rate of emergency readmission within 48 hours of PICU discharge.

3.7 PIM recalibration

Recalibration of PIM3 will be performed using the data to be published in the report (i.e. for the 2025 report, this would be admission years: 2022, 2023, and 2024). Recalibrated PIM3 co-efficient for each factor as obtained through a logistic regression model; exclusions apply for patients aged 18 years and over.

Recalibration is undertaken annually in Stata and the resulting coefficients saved in SQL for future reference.

Assessments of the recalibrated model will include examining the area under the Receiver Operating Characteristic (ROC) curve and goodness-of-fit assessments for discrimination ability and calibration. Both values will be reported alongside co-efficients as per the Health Quality Improvement Partnership (HQIP) outlier guidance[9].

3.8 Assumptions

Standard assumptions made in analysis are listed below. Additional specific assumptions based on stats checks will be documented.

Postcodes

Following the postcode validation processes, including manual review, if the postcode still cannot be validated by the address, then the postcode will be treated as unknown for analysis purposes in the State of the Nations report as the data are deemed to not be of sufficient quality for inclusion.

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[9] https://www.hqip.org.uk/wp-content/uploads/2021/11/Appendix-10-HQIP-Outlier-guidance-v4.pdf

Date and time of death

If date of death is missing and time of death is recorded as 00:00:00, then it will be assumed that time of death is an import error, and that the patient survived. The validity of this assumption will be checked using the discharge status field (*unitdisstatus*). Following this confirmation, time of death will be replaced with a missing value for those without a death date.

4 Analysis methods

4.1 Software

Analysis will be performed in SQL or Stata v18 (or later) (7) unless otherwise stated. Microsoft Excel will be used for deprivation calculations.

4.2 Statistical program validation

A header should be included in all statistics syntax files; as a minimum the header should include the program name and purpose, the author and date created. Additionally, a list of amendments made post review, last amended date, date of review and reviewers name should ideally be included. Programs can be validated by the author and do not need third party review, unless otherwise stated.

4.3 General analysis methods

Descriptive analysis comprises the largest part of the report. In the admissions dataset, most of the tables and figures are usually broken down by admitting PICU and year. The majority of tables and figures report data on admissions between 0-15 years of age, where all admissions are included in an analysis this will be clearly identified.

The report mainly focuses on year of admission. There are only a few sections of the report that focus on activity in the year rather than year of admission. Where data are presented based on date of activity, this is detailed in Section **Error! Reference source not found.** below.

Standardised mortality ratios

Unadjusted Standardised Mortality Ratios (SMRs) are calculated by dividing the observed number of deaths in each organisation by the expected number of deaths, based on the national data for the same admission period.

Risk-adjusted SMRs are calculated by dividing the observed number of deaths in each organisation by the expected number of deaths predicted using the recalibrated version of PIM3 (see Section 3.7). This provides case-mix adjustment based on PIM3.

Where an SMR equals one, the number of expected deaths equals the number of observed deaths.

4.4 Potential sources of measurement error and bias

4.4.1 Bias

Sampling bias

This national audit collects information from all PICUs in NHS England, NHS Wales, Scotland (NHS Lothian and NHS Glasgow and Clyde), Northern Ireland and ROI PICUs as well as private PICUs in England (Portland; Harley Street until 2020). Additionally, data are collected from all centralised UK and ROI paediatric critical care transport teams. As such, there is no sampling bias introduced as the entire population is collected.

Selection bias

PICANet has a Section 251 support (21/CAG/0090) which allows collection of data without individual patient/parental consent. PICANet is exempt from the national data opt-out (England) (for the purposes of audit). As such we collect data on all patients treated within participating PICUs with no selection bias introduced.

Bias introduced through missing data

Data being missing not at random can introduce bias into results. For example, data that are difficult to obtain and are not clearly accessible in patient records may be less likely to be reported. It is not believed that this is likely to apply in many cases and PICANet Web validation, validation visits, data cleaning and emails all focus on data completeness as well as quality. Levels and patterns of missing data will be reported as appropriate for transparency.

Bias may also be introduced via assumptions used to exclude any individuals from analysis, assumptions made will be recorded and reported as appropriate alongside analyses to allow the audience to assess the impact of such assumptions for themselves.

4.4.2 Measurement error

Transposition error

During the data entry process, data may be entered incorrectly into PICANet Web e.g. due to misreading clinical notes, handwriting legibility or human error. Virtual validation visits are

conducted to check the accuracy and completeness of data in order to detect such errors. Data cleaning may also identify issues and the database validations also apply a modulus 11 check on NHS number (where applicable). It is, however, likely that there will be a low underlying level of transposition error that will go undetected.

Interpretation error

Misinterpretation of PICANet definitions may also lead to inaccurate data. Training materials are publicly available including data definitions and examples of how to complete PICANet forms. Virtual validation visits are also used to pick up such systematic errors and improve data quality.

4.5 Missing data methods

Database validations flag missing data and virtual validation visits are used to ensure data completeness as well as quality. Patterns of missing data will be explored as appropriate for key data and variables. Missing data will be queried with units where appropriate.

There are no plans to use formal methods for missing data such as multiple imputation due to the descriptive nature of the State of the Nations Report. Numbers of missing data items will be presented alongside results as appropriate to aid interpretation.

4.6 Outlier detection

Detection of outliers is undertaken using funnel plots for the key metric of (risk-adjusted) mortality. The process for selecting the risk-adjusted in-PICU mortality metric and responding to outliers can be found in the 2024 update to PICANet's Detection and management of potential Level 3 Paediatric Critical Care Unit outliers Policy: https://www.picanet.org.uk/about/policies/.

4.7 Reporting conventions

Percentages will be reported to one or two decimal places (dp) unless otherwise stated. Totals are presented as whole numbers or to 1dp if required.

Any exclusions applied in analysis (e.g. exclusion of unknown age, ambiguous gender or neonatal teams) will be specified in the description or footnote of the associated chart or table. Additionally, charts and tables will clearly indicate whether analysis has been performed on

based on country of residence or country of treatment (i.e. location of PICU where admissions occurred).

Where a unit has not been open for the whole three-year reporting period, inclusion in tables which present data over the whole period must be considered on a case by case basis.

4.7.1 PICANet standard categorisations

The following categorisations will be used in analysis unless otherwise stated.

Admission type: planned following surgery; unplanned following surgery; planned other; unplanned other; unknown.

Age: <1 year; 1-4 years; 5-10 years; 11-15 years; 16+ years.

Country of admission: England (NHS and non-NHS); Wales; Scotland; Northern Ireland; Republic of Ireland. *N.B. occasionally providers in England are separated by NHS and non-NHS status.*

Deprivation: Deprivation quintile of patient's home address, defined by Townsend measure of deprivation. All LSOAs (/ Scottish Datazones) are ordered according to their Townsend score (higher score = more deprived). The LSOAs are then split into 5 equal groups based on population, by Townsend score so that group 1 contains the 20% most deprived population, Group 2 the second most deprived 20% of the population, and Group 5 contains least deprived 20% of the population and so on. Currently calculated for patients resident in England, Wales and Scotland admitted to PICU in these nations only.

Discharge destination: normal residence; hospice; same hospital; other hospital; unknown.

Ethnicity: We report ethnicity as per the ONS ethnic group classification 6a[10]: Asian; Black; Mixed; White; Other; Not stated / Unknown.

Long stay admission: Length of stay ≤28 days; >28 days

PIM group: <1%; 1%-<5%; 5%-<15%; 15%-<30%; ≥30%.

Primary diagnostic group: cardiovascular; endocrine/metabolic; gastrointestinal; infection; musculo-skeletal; neurological; oncology; respiratory; other; unknown.

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[10]
https://www.ons.gov.uk/census/census2021dictionary/variablesbytopic/ethnicgroupnationalidentitylanguageandreligionvariablescensus2021/ethnicgroup/classifications

The top eight most commonly occurring groups being presented with all other diagnostic groups and any unknown being combined into the 'Other' category for statistical disclosure control.

> Whenever used, a footnote should be added explaining that 'Other' includes a mixture of diagnoses but also some coding where a non-diagnostic SNOMED code was given e.g. 'Post-surgical wound care' and that this practice varies by organisation. Additionally, where 'Other' includes less common diagnostic groups this should also be transparent.

Sex: male; female; ambiguous; unknown.

Source of admission: same hospital; other hospital; clinic; home; unknown.

Ventilation status: invasive ventilation only; non-invasive ventilation only; both invasive and non-invasive ventilation; neither; unknown.

5 State of the Nations report content

5.1 Key metrics

Key findings are agreed upon by the co-PIs, statistician(s) and relevant clinicians.

The first table in the report will focus on the admissions and will include a count of admissions by year, broken down by sex, age group, ethnicity, deprivation and country of admission.

The State of the Nations report will also present the key metrics, introduced in Section 3.2. The report will make national recommendations based on the key metrics, in combination with supporting charts and data tables detailed below.

5.2 Interactive Charts and Data

We will present data in an interactive and user-friendly way using HighCharts; stakeholders will be able to access and download the data behind each chart. Data will be presented in charts thematically, broken down by selected factors.

5.2.1 Overall admission numbers

All charts and data tables in this section **exclude** patients aged 16 years and over, those of unknown, and patients of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

The outcome will be presented by:

- Year (all three years individually)
- PICU
- Country of admission
- ODN (Operational Delivery Network, England only)
- Age group
- Sex
- Ethnicity
- Deprivation quintile
- Primary diagnosis group
- PIM3 category

5.2.2 Bed days

All charts and data tables in this section **include** patients aged 16 years and over, and those of unknown age, but **excludes** children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

Bed days are reported based on the year of delivery, regardless of the year of admission.

The outcome will be presented by:

- Year (all three years individually)
- PICU
- Country of admission
- ODN
- Age group
- Sex
- Ethnicity
- Deprivation quintile
- Primary diagnosis group PIM3 category

5.2.3 Length of stay (days)

All charts and data tables in this section **exclude** patients aged 16 years and over, those of unknown age, and children of ambiguous or unknown sex, as well as children not discharged from PICU at the time of data lock. Data will be presented for 2024 only, unless otherwise stated.

Length of stay is presented based on year of discharge.

The outcome will be presented by:

- Year (all three years individually)
- PICU
- Country of admission
- ODN
- Age group
- Sex
- Ethnicity
- Deprivation quintile
- Primary diagnosis group
- PIM3 category

5.2.4 Long stay admissions

All charts and data tables in this section **exclude** patients aged 16 years and over, those of unknown age, and children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

Long stay admissions are defined as those with a length of stay greater than 28 days and are presented based on year of discharge.

The outcome will be presented by:

- Year (all three years individually)
- PICU
- Country of admission
- ODN
- Age group
- Sex
- Ethnicity
- Deprivation quintile

- Primary diagnosis group
- PIM3 category

5.2.5 Highest HRG level

All charts and data tables in this section **includes** patients aged 16 years and over, and those of unknown age, but **excludes** children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2023 only, unless otherwise stated.

Highest HRG level means that the charts include the data for the maximum level of care received for each admission.

The outcome will be presented by:

- Year (all three years individually)
- PICU

5.2.6 Proportion of emergency readmissions (Metric 3)

All charts and data tables in this section **exclude** patients aged 16 years and over, those of unknown age, and children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

The outcome will be presented by:

- Year (all three years individually)
- PICU
- Country of admission
- ODN
- Age group
- Sex
- Ethnicity
- Deprivation quintile
- Primary diagnosis group
- PIM3 category

5.2.7 Unplanned extubation rate (Metric 4)

All charts and data tables in this section **exclude** patients aged 16 years and over, those of unknown age, and children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

Presented as a rate per 1,000 ventilated days.

The outcome will be presented by:

- Year (all three years individually)
- PICU
- Country of admission
- ODN
- Age group
- Sex
- Ethnicity
- Deprivation quintile
- Primary diagnosis group
- PIM3 category

5.2.8 Crude mortality – number and proportion

All charts and data tables in this section **exclude** patients aged 16 years and over, those of unknown age, and children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

Presented based on year of admission, regardless of year of death.

The outcome will be presented by:

- Year (all three years individually)
- PICU
- Country of admission
- ODN
- Age group
- Sex
- Ethnicity
- Deprivation quintile
- Primary diagnosis group
- PIM3 category

5.2.9 Standardised mortality ratios

All charts and data tables in this section **exclude** patients aged 16 years and over, those of unknown age, and children of ambiguous or unknown sex, as well as children not discharged from PICU at the time of data lock. Data will be presented using **all three years of the reporting period combined**, unless otherwise stated.

Static tables will present: unadjusted SMRs; PIM3 risk-adjusted SMRs; and funnel plots for:

- The most recent year of the reporting period only (to identify 'alert' statuses)
- The three-years of the reporting period combined (to identify potential outliers)
- Level 3 admissions only for 0-15 year olds (defined by highest HRG group)
- 0-15 year olds excluding those discharged for palliative care
- 0-15 year olds receiving invasive ventilation only

PIM3 recalibrated co-efficients will also be presented.

5.2.10 Transport team mobilisation time (Metric 2)

All charts and data tables in this section **exclude** patients aged 16 years and over, but **include** patients people of unknown age, and children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

The outcome will be presented by:

- Year (all three years individually)
- Transport organisation
- Age group
- PIM3 category

5.2.11 Transport team time to bedside

All charts and data tables in this section **exclude** patients aged 16 years and over, but **include** patients of unknown age, and children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

The outcome will be presented by:

- Year (all three years individually)
- Transport organisation
- Age group

- PIM3 category

5.2.12   Data quality: Admissions

All charts and data tables in this section **include** patients aged 16 years and over, those of unknown age, and children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

- Data completeness by data item
- NHS/CHI number by PICU
- Completion within 2 months of discharge
- PIM3 data availability (0-15 years only)

5.2.13   Data quality: Transports

All charts and data tables in this section **include** patients aged 16 years and over, those of unknown age, and children of ambiguous or unknown sex, unless otherwise stated. Data will be presented for 2024 only, unless otherwise stated.

- Data completeness by data item
- NHS/CHI number by transport organisation
- Completion within 2 months of transfer

6 Signatures of approval

Name	Role	Signature	Date
Richard Feltbower	Co-Principal Investigator	*R. Feltb—*	05/12/2025
Hari Krishnan	PICANet Clinical Lead	*R. Hari Krishnan*	05/12/2025

7 References

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8 Related documents

National Paediatric Critical Care Audit State of the Nations Report 2025 Appendices

Appendix A – Database validation categories

Code	Validation type	Fires when	Example	Impact on manual data entry	Impact on data import	Manual override possible
4	Reject	Data type error	Text character in a numerical only field or incorrect length	Cannot save entry & flagged to user	Whole data import will be rejected & flagged to user	No
3	Error	Logical impossibility – data entered does not make logical sense	User tries to enter a date in the future	Can save the entry but error flagged to user	Import successful but user must amend erroneous data to clear the validation error	No
2	Warning	Unlikely value	Value outside expected range	Warning flagged to user	Warning flagged to user	Where specified; have to amend or confirm data are correct
1	Missing value*	Data is not completed	No value entered	Can save the entry but must amend data to fix the validation error	Can save but must amend data to fix the validation error	Where specified; state data unobtainable

* N.B. 9s are the given way of recording 'not available'. If 9s are entered then the missing value validation query will not fire as the field is completed with a defined acceptable value. There may be cases where a warning validation query fires where 9s are entered.

Appendix B – PIM3 variables

PIM3 comprises of the following variables:

Elective admission	
Pupil reaction	
Mechanical ventilation	
Absolute values of base excess	
SBP (systolic blood pressure) at admission	
$SBP^2/1000$	
$100x\ FIO_2/PaO_2$ (mmHg)	
Recovery from a bypass cardiac procedure	
Recovery from a non-bypass cardiac procedure	
Recovery from a non-cardiac procedure	
Very high risk diagnosis	Includes: Cardiac arrest preceding ICU admission Severe combined immune deficiency Leukaemia or lymphoma after first induction Bone marrow transplant recipient Liver failure is the main reason for ICU admission
High risk diagnosis	Includes: Spontaneous cerebral haemorrhage Cardiomyopathy or myocarditis Hypoplastic left heart syndrome Neurodegenerative disorder Necrotizing enterocolitis is the main reason for ICU admission
Low risk diagnosis	If any of the below is the main reason for ICU admission Asthma Bronchiolitis Croup Obstructive sleep apnoea Diabetic ketoacidosis Seizure disorder