Supplementary Material: Learnings From a National Cyberattack Digital Disaster During the Sars-Cov-2 Pandemic in a Paediatric Emergency Medicine Department

Supplementary Table 1.Feature Engineering Tasks

|  |  |
| --- | --- |
| Variable | Transformation Description |
| Discharge Group | The discharge destination was grouped into ‘Admitted to ward’, ‘Death’, ‘Did not wait’, ‘Home’, ‘PICU’, ‘Transfer to another hospital’ and finally ‘Other/Unknown’ in both data sources. |
| Presenting Complaint | The grouping was derived using decision rules combined with key word searches in the free text. This method was applied to the two data sources for consistency. Categorisation of presenting complaints was based on frequency of occurrence and clinical expert opinion. |
| Triage Category | Triage categories 1 and 2 were grouped together as were categories 4 and 5. These categories were grouped together due to the low numbers in categories 1 and 5 and the ability to carry out some of the statistical tests such as Mann-Whitney. Triage Category 3 was left as the third group. |
| Return (Within 7 days) | To calculate the return rate, the primary healthcare record (HCR) number from the Patient Administration System was linked to the patient’s visits within the previous seven days. Any temporary or duplicate HCR numbers were resolved. When assessing return visits, any attendances for which the HCR could not be determined were excluded from the algorithm. |

Supplementary Figure 1. Daily number of visits and median length of stay

Supplementary Table 2. Median and record counts for each patient flow duration and time period

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Time Period | Total Length of Stay (Min) | Registration to Triage (Min) | Triage to Clinician Review (Min) | Clinician Review to Discharge Ex Admitted (Min) | Clinician Review to Decision to Admit (Min) | Decision to Admit to Discharge (Min) |
| Prior to System Outage (42 days) | | | | | | |
| Count | 4471 | 4439 | 4189 | 3773 | 505 | 522 |
| Median (IQR) | 188 (107-292) | 11 (7-17) | 37 (16-100) | 77 (37-151) | 147 (71-235) | 186 (115-289) |
| System Outage (23 days) | | | | | | |
| Count | 2298 | 2196 | 2028 | 1810 | 257 | 267 |
| Median (IQR) | 166 (100-285) | 10 (5-15) | 34 (15-83) | 69 (34-133) | 135 (70-227) | 175 (104-269) |
| Restoration of Patient Admin System (9 days) | | | | | | |
| Count | 1029 | 1013 | 967 | 853 | 98 | 103 |
| Median (IQR) | 168 (99-272) | 9 (5-15) | 40 (17-97) | 63 (30-139) | 136 (67-242) | 174 (113-264) |
| Restoration of Radiology System (2 days) | | | | | | |
| Count | 229 | 206 | 209 | 187 | 26 | 26 |
| Median (IQR) | 165 (75-307) | 10 (5-15) | 23 (10-75) | 63 (31-120) | 161 (84-213) | 235 (158-317) |
| Restoration of Pathology System (7 days) | | | | | | |
| Count | 792 | 799 | 758 | 677 | 71 | 74 |
| Median (IQR) | 167 (98-258) | 6 (4-11) | 40 (18-99) | 60 (29-122) | 130 (57-218) | 195 (132-270) |
| Restoration of Emergency Department System (42 days) | | | | | | |
| Count | 4323 | 4300 | 4051 | 3668 | 468 | 483 |
| Median (IQR) | 185 (109-291) | 12 (7-19) | 33 (15-87) | 81 (39-153) | 145 (71-219) | 233 (143-354) |
|  |  |  |  |  |  |  |
| P | <0.001 | <0.001 | <0.001 | <0.001 | 0.70 | <0.001 |

IQR, interquartile range.

Supplementary Table 3. Post-hoc analysis following Kruskall-Wallis test

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Comparison of time periods with respect to Information Technology System status and restoration points | Total Length of Stay | Registration to Triage | Triage to Clinician Review | Clinician Review to Discharge Ex Admitted | Decision to Admit to Discharge |
| Prior to Outage v System Outage | + | + |  | + |  |
| System Outage v Patient Admin System |  |  |  |  |  |
| Patient Admin System v Radiology |  |  | + |  |  |
| Radiology v Pathology |  | + | + |  |  |
| Pathology v Emergency Department system | + | + | + | + |  |
| System Outage v Radiology |  |  |  |  |  |
| System Outage v Pathology |  | + |  |  |  |
| System Outage v Emergency Department System | + | + |  | + | + |
| Patient Admin System v Pathology |  | + |  |  |  |
| Patient Admin System v Emergency Department System | + | + |  | + | + |
| Radiology v Emergency Department System |  | + |  |  |  |
| Prior to Outage v Patient Admin System | + | + |  | + |  |
| Prior to Outage v Radiology |  | + | + |  |  |
| Prior to Outage v Pathology | + | + |  | + |  |
| Prior to Outage v Emergency Department System |  | + | + |  | + |

+ Kruskall-Wallis post-hoc testing, *P* < 0.05

Supplementary Figure 2. Visits for 3 Periods of Time (each period consisting of 6 weeks) in 2021 v 2019; Period 1 (5th Apr to 16th May 2019; from 2nd April to 13th May 2021), Period 2 (17th May to 27th Jun 2019; 14th May to 24th June 2021) and Period 3 (28th Jun to 8th Aug 2019; 25th June to 5th August 2021).

Supplementary Figure 3. Median LOS for 3 Periods of Time (each period consisting of 6 weeks) in 2021 v 2019; Period 1 (5th Apr to 16th May 2019; from 2nd April to 13th May 2021), Period 2 (17th May to 27th Jun 2019; 14th May to 24th June 2021) and Period 3 (28th Jun to 8th Aug 2019; 25th June to 5th August 2021).

STROBE Statement—checklist of items that should be included in reports of observational studies

|  |  |  |  |
| --- | --- | --- | --- |
|  | Item No. | Recommendation | Page  No. |
| **Title and abstract** | 1 | (*a*) Indicate the study’s design with a commonly used term in the title or the abstract | 1,2 |
| (*b*) Provide in the abstract an informative and balanced summary of what was done and what was found | 2 |
| Introduction | | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported | 3 |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses | 3 |
| Methods | | | |
| Study design | 4 | Present key elements of study design early in the paper | 3 |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection | 3 |
| Participants | 6 | (*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up  *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls  *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants | 3 |
| (*b*)*Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed  *Case-control study*—For matched studies, give matching criteria and the number of controls per case | Not applicable |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable | 4 and Supplementary table 1 |
| Data sources/ measurement | 8\* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group | 4 |
| Bias | 9 | Describe any efforts to address potential sources of bias | 4 |
| Study size | 10 | Explain how the study size was arrived at | 3 |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why | Supplementary table 1 |
| Statistical methods | 12 | (*a*) Describe all statistical methods, including those used to control for confounding | 4 |
|  |  | (*b*) Describe any methods used to examine subgroups and interactions | 3 |
|  |  | (*c*) Explain how missing data were addressed | 4 |
|  |  | (d) *Cohort study*—If applicable, explain how loss to follow-up was addressed  *Case-control study*—If applicable, explain how matching of cases and controls was addressed  *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy | Not applicable |
|  |  | (*e*) Describe any sensitivity analyses | Not applicable |
| **Results** |  |  |  |
| Participants | 13\* | (a) Report numbers of individuals at each stage of study—e.g., numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed | 6 and Table 1 |
|  |  | (b) Give reasons for non-participation at each stage | Not applicable |
|  |  | (c) Consider use of a flow diagram | - |
| Descriptive data | 14\* | (a) Give characteristics of study participants (e.g. demographic, clinical, social) and information on exposures and potential confounders | 5 and Table 1 |
|  |  | (b) Indicate number of participants with missing data for each variable of interest | 4,5,6, Table 1, Table 2, Table 3 and Table 4 |
|  |  | (c) *Cohort study*—Summarise follow-up time (e.g., average and total amount) | Not applicable |
| Outcome data | 15\* | *Cohort study*—Report numbers of outcome events or summary measures over time | 4, Table 1 |
|  |  | *Case-control study—*Report numbers in each exposure category, or summary measures of exposure |  |
|  |  | *Cross-sectional study—*Report numbers of outcome events or summary measures |  |
| Main results | 16 | (*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (e.g., 95% confidence interval). Make clear which confounders were adjusted for and why they were included | Not applicable |
|  |  | (*b*) Report category boundaries when continuous variables were categorized | Not applicable |
|  |  | (*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period | Not applicable |
| Other analyses | 17 | Report other analyses done—e.g., analyses of subgroups and interactions, and sensitivity analyses | 4,5 and Table 2 |
| **Discussion** |  |  |  |
| Key results | 18 | Summarise key results with reference to study objectives | 6 |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias | 6 |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence | 6,7,8 |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results | Not applicable |
| **Other information** |  |  |  |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based | Not applicable |

\*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.