COVID-19 in children with haematological malignancies

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ABSTRACT
Background Children with cancer are not at increased risk of severe SARS-CoV-2 infection; however, adults with haematological malignancies have increased risk of severe infections compared with non-haematological malignancies.

Methods We compared patients with haematological and non-haematological malignancies enrolled in the UK Paediatric Coronavirus Cancer Monitoring Project between 12 March 2020 and 16 February 2021. Children who received stem cell transplantation were excluded.

Results Only 2/62 patients with haematological malignancy had severe/critical infections, with an OR of 0.5 for patients with haematological compared with non-haematological malignancies.

Interpretation Children with haematological malignancies are at no greater risk of severe SARS-CoV-2 infection than those with non-haematological malignancies.

INTRODUCTION
Data previously published by our group have suggested that children with cancer are at no greater risk of severe infection with the coronavirus SARS-CoV-2 than other children.1 The UK Coronavirus Cancer Monitoring Project (UKCCMP) identified that adults with haematological malignancies were more likely to have a severe/critical phenotype than patients with non-haematological malignancies.2

Given that approximately 40% of children with cancer are diagnosed with a haematological malignancy, we performed a sub-analysis on our dataset to examine the severity of SARS-CoV-2 in this population.

METHODS
The UK Paediatric Coronavirus Cancer Monitoring Project (UKPCCMP) is a national database of children less than 16 with an underlying diagnosis of malignancy attending hospital with evidence of COVID-19 infection.3 The database was designed as a public health surveillance registry to support rapid clinical decision-making, in accordance with the UK Policy Framework for Health and Social Care Research, the UK National Research Ethics Service and the UK Governance Arrangement for Research Ethics Committees. Research Ethics Committee approval was not required, as confirmed by the Health Research Authority. Reporting is undertaken by named professionals in all 20 UK paediatric oncology Principal Treatment Centres.

Patients were eligible for inclusion if they had a positive SARS-CoV-2 reverse transcriptase polymerase chain reaction (RT-PCR) test between 12 March 2020 and 16 February 2021 and had an underlying diagnosis of any subtype of haematological malignancy including (but not limited to) all subtypes of leukaemia and lymphoma as well as myelodysplastic syndromes. Patients with other malignancies in the UKPCCMP cohort were used as a comparator. The cohort included both symptomatic and asymptomatic patients screened prior to elective admission to hospital.

Patients who had undergone an allogeneic stem cell transplant were excluded from the database as their information is being reported separately by the European Society for Blood and Marrow Transplantation (https://www.esmt.org/covid-19-and-bmt).

An OR was estimated with 95% CIs to describe the risk of developing a severe/critical phenotype of COVID-19 in the haematological malignancy subgroup compared with the non-haematological malignancy subgroup. The latter group included patients with various CNS tumours, sarcomas, neuroblastomas and other, rarer tumours.
severe/critical disease in patients with haematological compared with non-haematological disease was 0.50 (95% CI 0.08 to 3.11). Also, 80% of patients in the haematological cohort were receiving their first line of chemotherapy compared with 83% of patients in the non-haematological cohort.

**DISCUSSION**

In this updated analysis on our initial review of the severity of COVID-19 in children with cancer in the UK, we focus specifically on comparing patients with haematological and non-haematological malignancies.

Since the beginning of the pandemic, a number of groups including our own have published data on the severity of COVID-19 in children with cancer and on the severity of COVID-19 in patients with different haematological malignancies. This cohort specifically compares the severity of infection between paediatric patients with haematological and non-haematological malignancies.

The adult UKCCMP reported that patients with haematological malignancies have a significantly higher case-fatality rate than patients with non-haematological malignancies (OR 2.25, 95% CI 1.13 to 4.57). Similar findings have been reported by other groups.

In our haematological malignancy cohort, there were no deaths related to COVID-19 and only two patients required intensive care support. Also, 31% of patients were asymptomatic and were identified either through targeted screening prior to a general anaesthetic or were admitted for another reason instead of COVID-19.

In the UKPCCMP cohort, 63.6% of patients had a mild infection that either did not require admission to hospital or had a short stay with no need for additional therapy such as supplemental oxygen. This figure remains consistent with our previously reported cohort in which 63% of patients had a mild infection, highlighting the stability of the data over time.

Approximately 40% of children diagnosed with cancer across the UK have a haematological malignancy, but 54% of patients in the UKPCCMP paediatric cohort had a haematological malignancy, 76% of whom had ALL. Treatment for ALL lasts 2–3 years, compared with 6 months of treatment for most other malignancies, resulting in an on-treatment prevalence for ALL that is higher than its incidence. This may partly explain the high proportion of patients with ALL in our cohort. Others have proposed that the relatively greater and more prolonged lymphopenia of patients with haematological malignancies may render them more susceptible to contracting viral infections in general including SARS-CoV-2.

### Table 1 Demographics and severity of SARS-CoV-2 infection in the UKPCCMP cohort

| Sex              | UKPCCMP haematological cohort | UKPCCMP non-haematological cohort |
|------------------|-------------------------------|-----------------------------------|
| Male             | 35 (56%)                      | 34 (71%)                          |
| Female           | 27 (44%)                      | 14 (29%)                          |
| Median age (range) | 7 years, 7 months (4 months to 15 years, 9 months) | 3 years, 10 months (1 month to 15 years, 9 months) |
| Ethnicity        |                               |                                   |
| White            | 37 (59.7%)                    | 23 (47.9%)                        |
| Black            | 3 (4.8%)                      | 4 (8.3%)                          |
| Asian            | 13 (21%)                      | 8 (16.7%)                         |
| Other            | 3 (4.8%)                      | 4 (8.3%)                          |
| Undisclosed      | 6 (9.7%)                      | 9 (18.8%)                         |
| Severity of SARS-CoV-2 |                        |                                   |
| Asymptomatic     | 19 (30.6%)                    | 17 (35.4%)                        |
| Mild             | 39 (62.9%)                    | 27 (56.2%)                        |
| Moderate         | 2 (3.2%)                      | 1 (2.1%)                          |
| Severe           | 1 (1.6%)                      | 1 (2.1%)                          |
| Critical         | 1 (1.6%)                      | 2 (4.2%)                          |

UKPCCMP, UK Paediatric Coronavirus Cancer Monitoring Project.

### Table 2 Underlying diagnosis of patients with haematological malignancies in the UKPCCMP cohort

| Diagnosis           | Number (%) |
|---------------------|------------|
| Leukaemia           | 57 (92%)   |
| Acute lymphoblastic leukaemia | 48 (77.4)   |
| Acute myloid leukaemia | 8 (12.9)   |
| Acute leukaemia, not otherwise specified | 1 (1.6)   |
| Lymphoma            | 5 (8)      |
| Hodgkin’s lymphoma  | 3 (4.8)    |
| Burkitt’s lymphoma  | 2 (3.2)    |

UKPCCMP, UK Paediatric Coronavirus Cancer Monitoring Project.
The major strength of our study is that all principal treatment centres caring for children with cancer in the UK were enrolled. While some patients with positive SARS-CoV-2 PCR results may not have been registered on the UKPCCMP database, rigorous and repeated follow-up with participating centres has ensured near complete capture of childhood cancers attending hospital in the reported timeframe.

The major limitation of our study is the relatively small numbers of patients involved. However, the results shown here are remarkably similar to the data we published for all children with cancer last year. A specific limitation with regard to our haematological cohort is our elective omission of patients who had undergone an allogeneic stem cell transplant as they were being captured by another registry study. This decision does limit our ability to generalise our findings to all patients with haematological malignancies, but the conclusion that paediatric patients with cancer are at no greater risk of severe COVID-19 infection remains relevant for those who have not had an allogeneic transplant. Furthermore, less than 1% of patients with haematological malignancies in the adult UKCCMP cohort had allogeneic stem cell transplants (personal communication). This therefore means that, although we excluded patients who were post-allogeneic transplant from our dataset, the two sets are largely comparable.

CONCLUSION

Our data suggest that children with haematological malignancies who have not had an allogeneic stem cell transplant are not at greater risk of severe infection with SARS-CoV-2 than other children with cancer. This supports the recommendations that children with haematological malignancies need not be considered extremely vulnerable and should continue with standard of care therapy without modification attendant on the SARS-CoV-2 pandemic.

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