

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

- | | |
|--------------------------|--|
| n/a | Confirmed |
| ☐ | ☒ The exact sample size (<i>n</i>) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☐ | ☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☐ | ☒ The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☐ | ☒ A description of all covariates tested |
| ☐ | ☒ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☐ | ☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☐ | ☒ For null hypothesis testing, the test statistic (e.g. <i>F</i> , <i>t</i> , <i>r</i>) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☐ | ☒ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☐ | ☒ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☐ | ☒ Estimates of effect sizes (e.g. Cohen's <i>d</i> , Pearson's <i>r</i>), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection	Data on adult patients (age ≥16 years) with ALL who underwent their first allogeneic hematopoietic stem cell transplantation with myeloablative conditioning between 2000 and 2021 were obtained through the Transplant Registry Unified Management Program (TRUMP) sponsored by the Japanese Society for Transplantation and Cellular Therapy (JSTCT).
Data analysis	All statistical analyses were conducted using R version 4.1.1 (R foundation for Statistical Computing, Vienna, Austria) and Stata version 17 (Stata Corp., College Station, TX).

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

Data of this study are not publicly available due to ethical restrictions, as releasing them would exceed the scope of recipient/donor consent for research use in the registry.

Human research participants

Policy information about [studies involving human research participants and Sex and Gender in Research](#).

Reporting on sex and gender	We included the biologically determined sex, as assessed by clinicians, in the patient factors for analysis.
Population characteristics	Data on adult patients (age ≥ 16 years) with acute lymphoblastic leukemia who underwent their first allogeneic hematopoietic stem cell transplantation with myeloablative conditioning between 2000 and 2021 were obtained through the Transplant Registry Unified Management Program (TRUMP) sponsored by the Japanese Society for Transplantation and Cellular Therapy (JSTCT). Among 4652 patients, median age at transplantation was 37 years (range, 16–72), and 44.2% were female. 34.5% of the cases were positive for the Philadelphia chromosome.
Recruitment	The Transplant Registry Unified Management Program (TRUMP) collects clinical data on all hematopoietic stem cell transplant cases conducted throughout Japan.
Ethics oversight	The study was approved by the data management committees of the Transplant Registry Unified Management Program (TRUMP) and by the Institutional Review Board of Kyoto University Hospital, and was conducted in accordance with the Declaration of Helsinki.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	4652 patients were analyzed.
Data exclusions	Patients without survival data up to 1 year were excluded, since one of our major endpoints could not be assessed in them. Those who lacked HLA matching data, and those who underwent HLA-haploidentical transplantation using post-transplant cyclophosphamide were also excluded in order to minimize influence of HLA mismatch on transplant outcomes.
Replication	In this analysis, due to the limited number of cases, we did not prepare a validation cohort. However, we developed the model in a way that minimizes overfitting.
Randomization	In this study, randomization was not performed. In this study, where we compared intensified myeloablative conditioning with standard myeloablative conditioning, the choice between the two was made by the transplant centers at their discretion. Since there has been limited evidence supporting the rationale for selecting one over the other, the main purpose of this study is to evaluate the appropriateness of these choices using machine learning.
Blinding	Blinding was not implemented due to the retrospective nature of the study.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☒	☐ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☐	☒ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Clinical data

Policy information about [clinical studies](#)

All manuscripts should comply with the ICMJE [guidelines for publication of clinical research](#) and a completed [CONSORT checklist](#) must be included with all submissions.

Clinical trial registration	This study was approved by the Japanese Society for Transplantation and Cellular Therapy (JSTCT). The approval number is WG4-49.
Study protocol	Study protocol is available in the following URL. https://www.jdchct.or.jp/trump/
Data collection	The Transplant Registry Unified Management Program (TRUMP), supported by the Japanese Society for Transplantation and Cellular Therapy (JSTCT), collects clinical data on all hematopoietic stem cell transplant cases conducted throughout Japan.
Outcomes	We used 1-year overall mortality after transplantation. As secondary endpoints, we evaluated disease-free survival (DFS), non-relapse mortality (NRM), and relapse rate (defined as hematologic relapse).