

Deceased organ donation efficiency in Switzerland from 2014 to 2023 compared to other European countries according to the Donor Conversion Index (DCI) – an ecological study

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Summary

AIMS OF THE STUDY: Deceased donation activity is typically calculated as the number of donors per year per million people (pmp) and is referred to as the donation rate. To assess donation efficiency rather than donation activity, concepts such as the Donor Conversion Index (DCI) consider that not every death is eligible for organ donation. These are primarily deaths resulting from diseases associated with potentially devastating cerebral injury leading to brain death. We present the 2014–2023 evolution of the deceased donation activity and efficiency in Switzerland compared with selected European countries. How does Switzerland perform when organ donation programmes are evaluated using the DCI instead of the donation rate? The results are discussed in the context of implemented measures in Switzerland to increase organ donation activity.

METHODS: We calculated the DCI (number of donors divided by the number of eligible deaths, multiplied by 100), donation rate (number of donors divided by the number of residents, multiplied by 10⁶), and mortality rate (number of eligible deaths divided by the number of residents, multiplied by 10⁵) for each country and year using population-based data from the Global Observatory on Donation and Transplantation (GODT) and Eurostat. Eligible deaths for deceased organ donation include deaths from diseases associated with potentially devastating cerebral injury related to brain death, as defined by selected ICD-10 codes suggested by the European Directorate for the Quality of Medicines & Healthcare. We present trends for the years 2014–2023 for all three indicators and compare the results of Switzerland with those of seven European countries (Austria, France, Germany, Italy, the Netherlands, Spain, and the United Kingdom).

RESULTS: Over the 10-year study period, efficiency, as measured by the DCI, increased by 2–72% in all countries. In Switzerland, the DCI rose from 3.2 donors per 100 eligible deaths in 2014 to 5.5 donors per 100 eligible deaths in 2023, representing the largest increase in efficiency among the countries analysed (+2.3 donors per 100 eligible deaths, or +72%). The primary driver of Switzerland's improved donation efficiency was increased donations after circulatory determination of death (DCD) since 2016. The DCI offers a different perspective on donation activity compared with the donation rate expressed in pmp. The upward trend over the past decade in the countries analysed is less pronounced for the donation rate than for the DCI. This divergence is accompanied by a declining mortality rate of diseases eligible for donation during the period studied. At the end of the study period, Switzerland's total DCI ranked second among the countries analysed, following Spain, while its donation rate in pmp ranked fourth, following Italy and France. Among the countries analysed, Switzerland had the lowest mortality rate of diseases eligible for organ donation throughout the study period.

CONCLUSIONS: Despite declining next-of-kin consent rates, Switzerland's organ donation programme is among the most efficient in Europe, according to the DCI. If consent matched that of other countries, efficiency could be even higher. The increase in the DCI from 2014 to 2023 suggests that measures to increase organ donation rates in Switzerland may have been effective. Swiss emergency and intensive care staff appear to appropriately identify, refer, and manage potential deceased organ donors. When comparing trends in organ donation figures between countries, it is important to consider differences in mortality due to eligible diseases associated with potentially devastating cerebral injury leading to brain death.

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Introduction

The activity and efficiency of national deceased organ donation programmes are assessed by different methodologies, which primarily differ in how they define donor potential [1]. A common and straightforward approach determines donor potential at the level of the entire population of a country or region, dividing the number of donors by the number of residents. This figure is typically known as the donation rate and is expressed as donors per million population (pmp). Up-to-date national census data are readily available and enable quick and easy comparisons between countries. However, this approach has limitations. Most importantly, not all causes of death in the population are eligible for organ donation, and mortality due to those causes (mostly potentially devastating cerebral lesions related to brain death) may vary between countries and over time [2]. This may introduce bias when the donation rate pmp is used for country comparisons or when the evolution of national deceased organ donation efficiency is assessed over time.

An alternative approach is to define the deceased donor potential at the hospital level, that is, as the number of hospitalised patients who meet medical eligibility criteria [3–7]. However, this approach presupposes the review and analysis of medical records in all hospitals with intensive care units (ICUs), as is the case in Switzerland with the Swiss Monitoring of Potential Donors (SwissPOD) [8, 9]. In addition to data protection issues that arise when collecting individual health-related data, such a monitoring system requires significant financial and human resources. Furthermore, it is not always obvious whether a patient in the ICU or emergency department fulfils the medical eligibility criteria for deceased organ donation, and data collected in this way are not internationally comparable. In addition, monitoring deceased donor potential at the hospital level fails to assess the ability of an organ donation system to refer potential donors to hospitals with adequate facilities and resources for donor management.

A third approach, proposed by Weiss et al. [10] and others [11, 12], utilises official national cause-of-death statistics, which are typically available online or upon request by national or supranational administrations. The deceased donor potential is estimated at the population level using a set of causes of death that are eligible for deceased organ donation, with ICD-10 codes applied for diseases associated with potentially devastating cerebral injury leading to brain death. Weiss et al. (2018) proposed the utilisation of the Donor Conversion Index (DCI) as a metric for evaluating the efficiency of national deceased donation programmes, replacing the donation rate pmp approach. This is because the DCI provides an unbiased assessment, unaffected by variations in mortality rates resulting from deaths eligible for organ donation.

In this article, the efficiency of the Swiss organ donation programme is analysed and compared with that of selected European countries over a 10-year period from 2014 to 2023 using the DCI approach. Efficiency metrics are presented for programmes of donation after brain death (DBD pathway), programmes of donation after circulatory determination of death (DCD pathway), and overall national programmes combining DBD and DCD pathways. In comparison with previous publications that have used the DCI

[10, 13], the present study refines the methodology and uses more precise ICD-10 data, enabling a clearer definition of the deceased donation potential in accordance with the Guide to the Quality and Safety of Organs for Transplantation [14]. The DCI metric is compared with donation rates pmp, and the underlying specific mortality rates are presented to determine whether they vary between European countries and over time.

Materials and methods

Study design and setting

We retrospectively analysed routinely collected annual health data on organ donation (i.e. the number of actual donors) and causes of death (i.e. the number of eligible deaths) from 2014 to 2023. The Donor Conversion Index (DCI), a measure of donation efficiency; the donation rate (in pmp), a measure of programme activity; and the organ donation-specific mortality rate, which reflects the pool of eligible donors, were calculated for Switzerland and seven European countries (i.e. Austria, France, Germany, Italy, the Netherlands, Spain, and the United Kingdom).

Donor Conversion Index (DCI) = (number of donors / number of eligible deaths) $\times 10^2$ per year

Donation rate (in pmp) = (number of donors / number of residents) $\times 10^6$ per year

Mortality rate = (number of eligible deaths / number of residents) $\times 10^5$ per year

We followed the Reporting of Studies Conducted using Observational Routinely Collected Data (RECORD) guidelines [15]. All data were fully aggregated at the country level, consistent with an ecological study design. As no individual health-related data were used, ethics committee approval was not required for this study.

Data sources and population selection

Organ donation data

Annual data on deceased organ donation (2014–2023) for each country were obtained from the Global Observatory on Donation and Transplantation (GODT), a collaboration between the World Health Organization (WHO) and the Spanish Transplant Organization, Organización Nacional de Trasplantes (ONT). The dataset was downloaded from the GODT website [16]. The numbers of total actual deceased donors, actual DBD donors, and actual DCD donors were used. An actual donor is a deceased person on whom an operative incision was made with the intent of organ procurement for transplantation.

Data on causes of death eligible for deceased organ donation

Annual data on specific causes of death (2014–2023) for each country were obtained from Eurostat upon request (data extracted on 10.12.2024). The selection of causes of death eligible for deceased organ donation was based on the European Directorate for the Quality of Medicines & Healthcare's (EDQM) "Guide to the quality and safety of organs for transplantation" (table 2.3: International Classification of Diseases [ICD]-10 codes of conditions asso-

ciated with potentially devastating cerebral lesions related to brain death) [14] and included the following groups of cerebral lesions:

- cerebrovascular accidents (ICD I60–I66 and all sub-classifications)
- cerebral damage (ICD G93.1, G93.5, G93.6, and all sub-classifications)
- cerebral neoplasms (ICD C71, D33, and all sub-classifications)
- CNS infections (ICD G00, G01, G02, G03, and all sub-classifications)
- V01–V99, Y85 (transport accidents), used as a proxy for trauma because the corresponding ICD-10 codes were not available (i.e. S02 fracture of skull and facial bones, S06.1 traumatic cerebral oedema, S06.2 diffuse brain injury, S06.3 focal brain injury, S06.4 extradural haemorrhage, S06.7 intracranial haemorrhage with prolonged coma, S06.8 other intracranial injuries, S06.9 intracranial injury unspecified, according to table 2.3 of the EDQM guide to the quality and safety of organs for transplantation)

Note that potential DCD donors may have causes of death other than those listed above. However, we assume that patients who are successfully resuscitated but later undergo withdrawal of life-sustaining therapy are classified under anoxic brain damage (ICD code G93.1) according to the ICD. The extent to which this may limit the applicability of the DCI concept to DCD donors is addressed in the limitations section of the study.

The cause of death dataset included a total of 1,634,507 deaths. For 246 deaths (0.15‰), the underlying causes were withheld by Eurostat to prevent the identification of individuals. This information is withheld when fewer than four deaths have occurred for a certain cause in any combination of country, sex, year, and age group. These deaths may or may not have fallen under the relevant ICD classifications; therefore, they were removed from the dataset for analysis. Deaths in the Principality of Liechtenstein were added to the number of deaths in Switzerland, as organ donors from Liechtenstein are included in the Swiss donation figures.

In the time series of causes of death, certain years were missing for some countries. These missing data points were imputed using the PROGNOSIS.ETS function in Microsoft Excel when they occurred at the end of the time series (2019–2023 for the UK, 2022–2023 for Germany and Italy, 2023 for all other countries). For missing data within the time series (Austria, 2019 only), the moving average of the preceding and the following year was used.

Demographic data

Census data (2014–2023) for each country were retrieved from the Eurostat Data Browser [17] and are based on the resident population on 1 January of each year. The latest available numbers of the resident population, provided by Eurostat, were used as the denominator to calculate consistent donation rates pmp. Our donation rates may slightly differ from those published elsewhere due to the use of different population data in those sources.

Data cleaning and analysis

Country identifiers in all datasets were harmonised using ISO 3166-1 alpha-2 country codes with the R package “countrycode” to ensure consistency across sources. Data cleaning and processing were performed using R version 4.4.2 (R Project for Statistical Computing).

Donation efficiency (DCI) and donation activity (donation rate) were analysed separately for each country and for both the DBD and DCD pathways. Specifically, DCI was calculated as the number of DBD or DCD donors divided by the number of eligible deaths, and the donation rate was calculated as the number of donors per million residents. These metrics were also computed for both pathways combined (i.e. the total number of donors divided by the number of eligible deaths and the total number of donors divided by the number of residents, respectively).

To assess the evolution of donation efficiency over time in individual countries, DCI time series were plotted, and both absolute and relative changes (in percentages) in the DCI from 2014 to 2023 were calculated. Donation efficiency was then compared to donation activity by analysing country rankings according to both the DCI and donation rate at the end of the study period (2023). Additionally, we conducted a qualitative visual comparison of trends in the DCI and donation rate over the entire study period using their respective line plots.

Results

Efficiency of national organ donation programs from 2014 to 2023

The efficiency of deceased donation programmes was measured in eight European countries using the Donor Conversion Index (DCI), which calculates the number of donors per 100 eligible deaths. Over the 10-year study period, efficiency increased in all countries by 2–72%. Switzerland demonstrated an increase in the DCI, which rose from 3.2 donors per 100 eligible deaths in 2014 to 5.5 donors per 100 eligible deaths in 2023. This represents the most substantial improvement in efficiency among all countries (+2.3 donors per 100 eligible deaths, or +72%). Switzerland's efficiency increase is attributable to a 6.75-fold increase in DCD activity since 2016, from 0.4 to 2.7 donors per 100 eligible deaths. Swiss DBD activity remained relatively stable throughout the study period (from 2.7 in 2014 to 2.9 in 2023). Spain and the UK showed comparable trends to Switzerland, with a substantial increase in overall donation programme efficiency (+29%), also primarily driven by increased DCD activity rather than DBD activity (figure 1, table 1).

Other countries also substantially increased their organ donation efficiency over the 10-year study period, primarily due to an increase in DBD activity, as demonstrated in Italy (+39%) and Germany (+38%). While Germany has no DCD programme due to legal prohibition, Italy has relatively few DCD donors compared with most other countries. In contrast, in the Netherlands, the United Kingdom, and Switzerland, the proportion of DCD donors among all donors increased steadily, with DCD accounting for almost half or even more than half of all donors in 2023 (figure 1, table 1).

The DCI provides different results from the donation rate pmp. For instance, the positive trend over the past decade is less pronounced for the donation rate than for the DCI. While the DCI increased in all countries from 2014 to 2023 (by 2–72%), the organ donation rate increased by 2–58%,

and Austria's organ donation rate declined by 17% (figure 2). The divergent evolution of the DCI and donation rate is accompanied by a decrease in mortality from diseases associated with potentially devastating cerebral lesions leading to brain death. Mortality also declined over the study

Figure 1: Total (A), DBD (B), and DCD (C) efficiency of national organ donation programmes according to the donor conversion index (DCI). Germany (DE) has no DCD programme (prohibited by law). In the time series of eligible deaths (the denominator in the DCI), data had to be imputed for certain years and countries (see the "Materials and methods" section for details). DBD: donation after brain death; DCD: circulatory determination of death; AT: Austria; CH: Switzerland; DE: Germany; ES: Spain; FR: France; GB: the United Kingdom; IT: Italy; NL: the Netherlands.



period (except in Spain) (figure 3). In Spain, the UK, and Switzerland, a previously positive trend in organ donation efficiency halted in 2020. A similar drop in efficiency was observed in France and Italy during the same period (figure 1).

Efficiency of national organ donation programmes in 2023

A comparison of the countries at the conclusion of the study period in 2023 reveals that the DCI presents a different picture from simple donation rates. For instance, Switzerland's total DCI ranked second among the countries analysed, following Spain, while in terms of donation rate

Table 1: Efficiency of deceased organ donation programmes (DBD and DCD) by country according to the DCI at the beginning and end of the study period, as well as absolute and relative DCI changes. Countries are ordered by 2023 DCI.

Country	Donor conversion index (DCI)			
	2014	2023	Absolute change	Relative change
Spain (ES)	6.3	8.2	1.9	29%
Switzerland (CH)	3.2	5.5	2.3	72%
France (FR)	4.7	5.1	0.3	7%
Italy (IT)	3.5	4.9	1.4	39%
United Kingdom (GB)	3.5	4.5	1.0	29%
Austria (AT)	3.9	3.9	0.06	2%
The Netherlands (NL)	3.1	3.5	0.4	12%
Germany (DE)	1.6	2.2	0.6	38%

DBD: donation after brain death; DCD: circulatory determination of death; DCI: Donor Conversion Index.

Figure 2: Deceased organ donation rates per million population (pmp). AT: Austria; CH: Switzerland; DE: Germany; ES: Spain; FR: France; GB: the United Kingdom; IT: Italy; NL: the Netherlands.

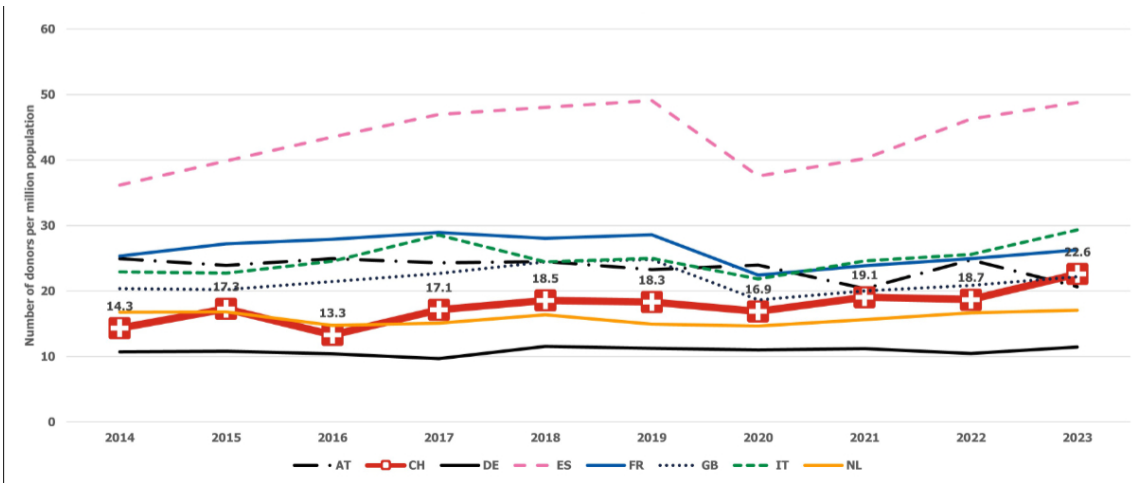
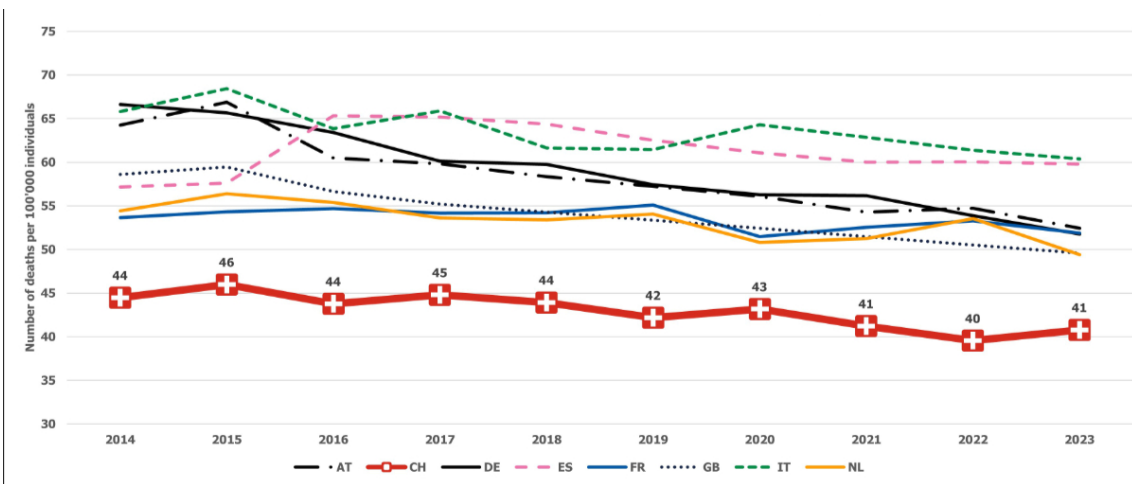


Figure 3: Mortality rates of diseases associated with potentially devastating cerebral lesions related to brain death (not age-standardised deaths eligible for organ donation). AT: Austria; CH: Switzerland; DE: Germany; ES: Spain; FR: France; GB: the United Kingdom; IT: Italy; NL: the Netherlands.



pmp, Switzerland ranked fourth, after Italy and France. Notably, although countries such as Italy and France exhibit higher donation rates than Switzerland, their DCI figures are lower (table 1 and table 2). This discrepancy is accompanied by higher mortality rates in Italy and France for diseases associated with potentially devastating cerebral lesions leading to brain death (figure 3). Switzerland has fewer organ donors pmp than Italy and France, but its potential for organ donation relative to the population is also lower. Consequently, as of 2023, Switzerland's organ donation programme is more efficient than those of Italy and France, given Switzerland's comparatively lower organ donor potential.

Figure 3 also shows that Switzerland had the lowest organ donation-eligible mortality rate of all countries throughout the study period. In 2023, Switzerland recorded 41 eligible deaths per 100,000 individuals, compared with 49 to 60 eligible deaths per 100,000 individuals in the other countries analysed. Since 2015/2016, mortality from organ donation-eligible diseases declined in all countries, with an average decrease of approximately 10%. This decline reflects a reduction in the potential for organ donation, as fewer individuals die from causes associated with potentially devastating cerebral injury leading to brain death.

Discussion

The increase in Switzerland's organ donation efficiency from 2014 to 2023 is encouraging. Overall efficiency, measured as the number of donors per 100 eligible deaths, increased by 72% over the 10-year period, representing the greatest increase among the nations analysed. At the conclusion of the study period in 2023, Switzerland's deceased donation programme ranked among the most efficient in Europe, second only to Spain. This suggests that Swiss emergency and ICU staff effectively identify, refer, and manage potential deceased organ donors.

This positive trend is mainly attributable to a significant increase in DCD activity since 2016. DCD activity increased 6.75-fold over seven years, while DBD activity has remained relatively stable since 2014. The stability of DBD activity despite the rise in DCD activity is noteworthy, as there were initial concerns that the introduction of DCD would come at the expense of DBD activity. Switzerland, along with other countries such as Spain and the UK, demonstrates that this does not necessarily have to be the case.

DCD programmes were reintroduced in 2011 and subsequently promoted by Swisstransplant and the National Committee for Organ Donation in numerous hospitals. To date, 10 out of 14 organ procurement hospitals have established a DCD programme, and 3 more are in the process of doing so. In addition, other measures have been undertaken in Switzerland to increase the efficiency of deceased organ donation. The national action plan "More organs for transplants" (2013–2021) [18, 19] is regarded as a fundamental prerequisite for various initiatives, including the promotion of DCD. This plan established the necessary structures and resources to develop and implement specific measures. The action plan comprised four fields of action: (1) training healthcare professionals; (2) process and quality management; (3) hospital structures and resources; and (4) public awareness campaigns and public relations. Each of these was implemented as a sub-project. The first three sub-projects were led by Swisstransplant and the National Committee for Organ Donation (CNDO), while the fourth was led by the Federal Office of Public Health. The effectiveness of such fundamental national measures typically becomes apparent only after a delay. Our results are consistent with the intended impact of the national action plan.

Swiss Monitoring of Potential Donors (SwissPOD) may have also contributed to the positive developments observed in Switzerland. Since 2012, this quality assurance tool has facilitated the ongoing evaluation and improvement of donation processes at the hospital level and promoted awareness of deceased organ donation among critical care personnel in hospitals [9]. In 2021, Swisstransplant developed and introduced the Donor Evaluation Tool. This digital tool supports local hospital organ donation coordinators in reporting potential donors to Swisstransplant and assists with eligibility decisions in uncertain or complex donor cases, potentially increasing the number of actual donations. For example, in 2022, more than 50% of potential donors assessed and initially accepted through the tool became actual donors [20].

In Switzerland, consent for organ donation from the deceased is required, and this is discussed with the next of kin at the donor hospital. If the wishes of the deceased are unknown, the next of kin must be asked on their behalf. Since 2021, Switzerland's consent rate in approaches involving next of kin (number of consents divided by the number of next-of-kin approaches) has been declining. By 2023 (the end of the study period), only 42% of these approaches resulted in consent to organ donation, while in 58% of cases, organ donation was refused [21]. Compared with other

Table 2: Organ donation activity (number of donors per million population [pmp]) and efficiency (donor conversion index [DCI]: number of donors per 100 eligible deaths) at the end of the study period in 2023. Countries are ranked by activity; in the right-most column, which presents each country's rank by efficiency, the difference from the activity ranking is shown in brackets.

Country	Activity		Efficiency	
	pmp	Rank	DCI	Rank
Spain (ES)	48.8	1	8.2	1
Italy (IT)	29.3	2	4.9	4 (−2)
France (FR)	26.3	3	5.1	3
Switzerland (CH)	22.6	4	5.5	2 (+2)
United Kingdom (GB)	22.2	5	4.5	5
Austria (AT)	20.6	6	3.9	6
The Netherlands (NL)	17.1	7	3.5	7
Germany (DE)	11.4	8	2.2	8

countries, Switzerland's refusal rate is high; most analysed countries reported lower refusal rates (Germany, 46%; the Netherlands, 45%; the UK, 39%; Italy, 30%; and Spain, 19%; no data are available for Austria and France) [22]. Switzerland's encouraging efficiency figures must be interpreted in light of these relatively high refusal rates. If Switzerland's refusal rate were comparable to those of other countries, the efficiency of the deceased organ donation programme could be even higher. On 15 May 2022, the Swiss population voted to introduce an opt-out system (also known as deemed or presumed consent), and refusal rates are expected to decline once this system comes into force. Additional measures have also been proposed in the literature to reduce refusal rates in next-of-kin approaches, including the introduction of specialised nurses [23, 24].

Our results suggest that deceased organ donation programmes should not be assessed solely by their donation rate pmp, which reflects donation activity rather than efficiency. While the prevailing donation rate pmp reflects national donation activity, the DCI metric better reflects national donation efficiency by accounting for variations in mortality from diseases associated with potentially devastating cerebral injury leading to brain death. Mortality rates due to these causes differ substantially between Western European countries and have continued to decline over time. Therefore, the potential for organ donation does not represent the same proportion of the total population in each country, and in all analysed countries, this potential has been shrinking since 2016. When assessing and comparing organ donation efficiency, differences in donor potential must be considered, as is the case in the DCI approach. The DCI approach reduces this bias and enables fairer comparisons. This is particularly important for countries such as Switzerland, which has a relatively low mortality rate from diseases associated with potentially devastating cerebral injury leading to brain death.

We observed a decline in donation efficiency in 2020 across most countries, which we attributed to the global COVID-19 pandemic. This temporary decrease is most likely due to the restriction or suspension of donation processes during the pandemic, rather than an increase in organ donation-specific mortality. An analysis of mortality data revealed no evident impact of the pandemic on the number of deaths eligible for organ donation.

Strengths and limitations of the study

The DCI accounts for variation in mortality from eligible diseases by country and over time, enabling a less biased comparison of the evolution of deceased organ donation activity across countries compared with the simple comparison of donation rates pmp. In other words, the DCI allows for a comparison of donation efficiency rather than donation activity. Furthermore, the DCI is easy to understand, as donation efficiency is expressed as the percentage of donors among eligible deaths. Finally, the required data are readily available from standardised databases in many countries, and the ICD classification is widely accepted worldwide.

The DCI concept is based on diseases associated with potentially devastating cerebral injury leading to brain death. However, potential donors for DCD are not limited to these patients; they also include individuals with circulatory fail-

ure who are medically suitable for organ donation. This means that the DCI may slightly overestimate donation efficiency in countries with a high proportion of DCD, as these countries have more actual donors (numerator) who may not be fully represented by the number of eligible deaths (denominator). In the case of controlled DCD, in which cardiac arrest is planned and expected following the withdrawal of life-sustaining therapy, we estimate that approximately 95% of deaths are captured by the DCI. This is because controlled DCD cases are mostly associated with underlying conditions that also cause potentially devastating brain injury leading to brain death. For example, 2023 data from the Swiss Organ Allocation System show that 56% of DCD donors died from anoxia, 29% from cerebrovascular accidents, 9% from traumatic brain injury, and only 5% from other causes [25]. It is assumed that in countries where controlled DCD predominates, the distribution of causes of death among DCD donors is relatively uniform. Therefore, the bias introduced by the DCI, specifically the potential to overestimate donation efficiency when comparing countries, is expected to be minimal. However, the DCI may somewhat overestimate donation efficiency in countries where uncontrolled DCD is common, such as France and Spain, because a higher proportion of actual donors in those countries are not captured by the number of eligible deaths used in the denominator. Uncontrolled DCD refers to donation from individuals who die following an unexpected cardiac arrest and cannot be successfully resuscitated [26].

It should also be noted that statistics on causes of death are only available with a two-year delay. To ensure data timeliness, figures for the most recent years had to be imputed (2022: three countries; 2023: all eight countries). Notably, due to the UK's exit from the EU, data for the UK were only available until 2018 and were imputed for 2019 to 2023. In addition, the ICD-10 codes that define traumatic brain injury, as listed in table 2.3 of the EDQM's *Guide to the Quality and Safety of Organs for Transplantation* [14], were not available from Eurostat. As a proxy, transport accidents were used instead.

Conclusion

The DCI clearly demonstrates Switzerland's high donation efficiency compared with other European countries. Despite declining consent rates in next-of-kin approaches, Switzerland's organ donation programme remains among the most efficient in Europe, according to the DCI. If consent rates were comparable to those in other countries, overall efficiency could be even higher. The data indicate that Swiss emergency and intensive care staff effectively identify, refer, and manage potential deceased organ donors and suggest that measures implemented in recent years to increase organ donation rates have been effective. When comparing organ donation trends across countries, it is important to consider differences in mortality from diseases associated with potentially devastating cerebral injury leading to brain death.

Data sharing statement

The data used for this study are publicly available. Corresponding contacts or internet addresses are referenced in the Materials and methods section. Any code used for data

cleaning and processing is available from the corresponding author upon request.

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Potential competing interests

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflict of interest related to the content of this manuscript was disclosed.

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