



# Post mortem tissue donation in the Netherlands: a nationwide approach

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**Abstract** In this article we describe the organization of post mortem tissue donation in the Netherlands, the average number of tissue donors procured during the years 2015–2019 and the main challenges we face to improve this number. Licensed by the Dutch Ministry of Health, the Dutch Transplant Foundation (NTS) plays a central role in the organization of tissue donation. The NTS works closely with the Dutch hospitals, two tissue banks and a procurement organization. Potential tissue donors are reported to the NTS 24/7. After consulting the Donor Register and relatives give consent for donation, donors are subject to a thorough medical evaluation. If no medical contraindication is mentioned, the donor is approved for tissue donation. Each year, tissues of an average of

1918 donors (112.1 donors Per Million Population) are procured. After procurement of tissues, donor blood and tissues are tested on virology and quality respectively. Based on the test results and the assessment of potential disease transmission, tissues can either be released for transplantation or discarded. In conclusion, the Netherlands has developed a uniform, nationwide approach for safe and efficient post mortem tissue donation in which the NTS plays a central role. In the past 5 years, tissues from a considerable number of donors are procured. The NTS will continue to work together with their partners, by stimulating donor recognition, registration of the donor will, relatives' informed consent and by extending donor selection criteria, for an even more efficient way to help patients on the waiting list for a transplantation.

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## Abbreviations

DP Donation professional  
NTS Nederlandse transplantatie stichting (Dutch Transplant Foundation)  
PMP Per million population

## Introduction

In 1998, the Dutch Organ Donation Act was introduced in the Netherlands to regulate organ and tissue donation. Among other things, this act states that everyone who is aged 12 or older and registered with a Dutch municipality may make a choice about organ and tissue donation and can have that choice registered.

As part of the Act, the Dutch Transplant Foundation (Nederlandse Transplantatie Stichting; NTS) was made responsible by the Dutch Ministry of Health, Welfare and Sport for organ and tissue donation and allocation in The Netherlands. The NTS works closely with Eurotransplant (mandated by the NTS to match and allocate organs) and with the Dutch hospitals, the national Donor Register, tissue banks, a procurement organization, insurance companies as well as patient organizations to help patients on the waiting list with an organ or tissue transplant. The NTS is a designated and registered non-departmental public body that is not only required to comply with the Dutch law and European regulations in respect of organ and tissue donation and allocation, but also to the international quality standard ISO 9001:2015. An independent third party, an accredited certification body, audits the NTS on a yearly basis in order to determine the compliance to the ISO 9001:2015 standard. Furthermore, the NTS undergoes inspections of the competent health authorities on a regular basis.

In this article we describe how the tissue donation process is organized in the Netherlands. We also present the number of post mortem donors from which tissues were procured for transplantation during the years 2015–2019. In the Netherlands cornea, sclera, skin, heart valves, blood vessels, and bone-, cartilage- and tendon tissues can be donated.

## Tissue donation process

### Donor recognition

The first step in the tissue donation process is the recognition of a potential donor by the treating physician in one of the 8 university hospitals or 81 general hospitals in the Netherlands. Donation Coordinators (nurses trained in organizing donation) are active in each hospital. They raise awareness for organ

and tissue donation with the medical professionals in the hospital, and inform physicians about (changes in) medical contra-indications. They also play an important role in improving donor recognition by retroactively checking the decision of the physician about the suitability of the donor. In university hospitals these activities are also performed by Transplant Coordinators. To further aid the physician, the NTS developed a pocket card which contains the most important general contra-indications for donation. The NTS also organizes several education sessions each year in which Donation Coordinators and Transplant Coordinators are informed about organ- and tissue donation, its indications and (medical) contraindications.

### Consultation of the donor register and discussing consent with relatives

If there is a potential donor, the physician will call the NTS to find out if the donor is registered in the Donor Register. This can be done 24 h a day, 7 days a week. The NTS operates a call center staffed by a team of two to five Donation Professionals (DP's) and at least one medical doctor. All DP's have a (para)medical background and are extensively trained for the medical screening of the tissue donor and the organization of the donation process. The DP will first ask if the patient is a potential organ donor. If so, the reporting physician will be referred to a regional Transplant Coordinator who is a specialized nurse or doctor who manages organ donation in the hospital. When the patient is also a potential tissue donor, the Transplant Coordinator or reporting physician will again contact the NTS later on.

**Table 1** Outcomes of the national Donor Register and number of citizens registered on January 2020

Donor will in the register	Number of citizens
Consent*	3831,390
Objection	2328,320
Relatives have to decide	779,788
A designated person has to decide	

\*Including consent with restriction for some tissues (<https://www.donorregister.nl/over-het-donorregister/cijfers>. Accessed 7 February 2020)

Dutch citizens can register their donor will from the age of 12 years. For donors younger than 12 years old (both) parents have to give permission for donation. Table 1 shows the outcome Dutch citizens can choose in the Donor Register and the number of registrations on January 1st 2020.

The DP will consult the Donor Register to see whether the potential donor is registered. On average 11.118 consultations were performed each year during the years 2015–2019. The physician will discuss the outcome of this consultation with the relatives of the deceased. In absence of registration the relatives have to give permission for donation. On average 2604 tissue donors per year were officially reported to the NTS, after consent was given.

### Donor screening

Before the consultation of the Donor Register, the DP will check some frequently occurring general (medical) contraindications such as, age above 85 years old, hematologic malignancy or premalignant hematologic or neurodegenerative disorder to prevent unnecessary consultations and discussion about donation with the relatives. If consent for donation is obtained, the physician officially reports the donor to the NTS. The DP then goes through an extensive (medical) questionnaire with the reporting physician over the phone. This questionnaire addresses the cause of death, medical, social and travel history and tissue specific contra-indications. If the reporting physician does not know the answer to a question or is not sure about the answer he will ask the family. The DP does not interview the family directly. Based on a structured work protocol and a list of general and tissue specific contraindications, the DP can approve cornea donors by themselves. In more complex cornea donor cases or in case of other tissues, the medical doctor of the NTS will decide.

### Procurement

If the deceased is approved for donation, a procurement team will retrieve the eligible tissues within 24 h. In the Netherlands one procurement organization called Stichting Weefsel Uitname Organisatie Nederland or WUON is active. This organization consists of a number of teams operating from three different locations in the country. The teams perform a

physical examination, retrieve donor blood (or pick up pre-transfusion blood from the hospital laboratory) and procure the tissues. On average, from 1918 donors tissues were procured each year during 2015–2019. With a population of 17.1 million people, this corresponds with a tissue donation rate of 112.1 per million population (PMP).

### Quality assessment

The blood is transported to the virology department of Dutch blood bank (Sanquin). Sanquin performs diagnostic tests to detect HIV, Hepatitis B and C, HTLV and *Treponema pallidum*, and since April 2020 SARS CoV-2. The tissues are transported to the tissue banks for processing, quality assessment and storage. In the Netherlands there are two banks working with post mortem tissues: Amnitrans Eye Bank Rotterdam (corneas only) and ETB-Bislife (cornea/sclera/skin/heart valves/blood vessels/bone-tendon).

### Release of donors

All relevant data that is generated by the DP's, medical doctor, procurement organisation, blood bank and tissue banks is collected by an application called 'Vita' and stored in a database. This custom made application, operated by the NTS, was designed to support the donor screening process. All the donor information is analysed by a staff of six medical doctors employed by the NTS. After a thorough medical evaluation they ultimately decide if the tissues are medically safe for transplantation or should be discarded. Their decision is not only based on the aforementioned information, such as cause of death, medical and social history, but also on other information, such as information from the general practitioner, autopsy reports and culture results. The policy for medical screening of post mortem tissue donors is evaluated twice a year by the medical team of the NTS in close collaboration with the Dutch tissue banks.

### Release of tissues

The tissue banks are responsible for the release of tissues. After a quality check, the tissue banks distribute the suitable tissues to the recipients in the hospitals.

## Conclusion and discussion

The Netherlands has developed a uniform, nationwide approach for safe and efficient post mortem tissue donation. The NTS plays a central role and works closely with the Dutch hospitals, the tissue banks and a procurement organization. On average from 1918 post mortem tissue donors (112.1 donors PMP) tissues are procured per year. The majority of these donors are cornea donors only (Table 2). In 2018 the Netherlands had one of the highest numbers for cornea (128.2), skin (21.4) and heart valve donors (12.6) PMP compared to other European countries (EDQM 2019). Despite the high number tissue donors PMP in the Netherlands, there is still room for improvement.

### Sub-optimal recognition of tissue donors

Although recognition of organ donors is high in the Netherlands, recognition of tissue donors is still sub-optimal among hospital doctors. Most physicians are not frequently confronted with a deceased patient and do not have much experience with the donation procedure. It was suggested to support the physicians in hospitals in the recognition of a tissue donor and to better inform them about the contraindications (van Wonderen et al. 2018; Vorstius Kruijff et al. 2014). The NTS has developed e-learning programs to increase donor recognition. The NTS is also developing a concept to introduce a new type of DP in the hospital. These DP's would be responsible for the entire process of donor recognition, consultation of the Donor Register, communication with the relatives and reporting of the donor. The introduction of these DP's

**Table 2** Mean number (and number PMP) of tissue donors per type of tissue procured for transplantation in the Netherlands during the years 2015–2019

Type of tissue	Number (PMP)
Cornea	1744 (102)
Skin	417 (24)
Heart valve (s)	193 (11)
Thoracic aorta	24 (1.4)
Cartilage-/tendon-/bone tissue	144 (8.4)

could have a positive effect on the number of reported tissue donors in the Netherlands.

### Low registration rate

Despite annual campaigns and other government initiatives to increase the number of registrations, the registration rate for donation in the Netherlands is low. Only 58% of the Dutch population is registered (CBS 2018). In February 2018 the Dutch Parliament, after a long debate, decided to change the current consent system from an opt-in system into an opt-out system. From September 2020 all non-registered citizens are invited by letter to register their donor will in the Donor Register. If they do not respond within a given time, they will be entered in the Donor Register as having 'no objection'. It will be interesting to see if the new act will lead to more tissue donations.

### High refusal rate among relatives

Another important bottleneck in post mortem donation is the high refusal rate among relatives. A study on potential organ donors has shown that relatives do not give permission in 61% of cases if the deceased is not registered in the Donor Register or has left the decision to the relatives. If the deceased is registered with consent, the refusal rate by the relatives is still 6% (van Leiden et al. 2010). Compared to organ donation, the situation with tissue donation is even worse (80% and 23% refusal rate), probably because relatively more physicians are involved that have no experience with the donation procedure or are not assisted by a transplant coordinator (NTS annual report 2018). This is in large contrast to studies that have shown a higher commitment in favor of donation in the Dutch population (Figuroa et al. 2013; CBS report 2012). The introduction of the new opt-out system will be combined with extra national campaigns about the importance to register and the importance to start a conversation with each other about the possible wish to donate. These campaigns could also draw extra attention to the Dutch population about the possibility to donate tissues and the improved quality of life of patients after tissue transplantation.

## Extending criteria for tissue donation

Just like in other countries, the population of the Netherlands is ageing. The average age of death was 75.2 years in the year 2000, and has increased to 78.5 years in the year 2018 (CBS Statline 2019a, b). Furthermore, the number of relatively younger people who die due to traffic accidents has decreased in recent decades [from 1166 persons in the year 2000 to 678 persons in 2018 (CBS Statistics 2018)]. On the other hand, there is an increasing demand for especially corneas for transplantation. While the number of corneas transplanted in the Netherlands increased from 1328 to 1701 during the years 2014–2018, the number of patients on the cornea waiting list remained around 600–700 (NTS Annual Report 2018). An option to increase the number of donors is to extend the criteria for tissue donation according to new knowledge and possibilities in tissue management. In the past years, the NTS has increased the maximum donor age for each type of tissue. In 2010 the NTS changed the maximum age for cornea donation from 75 to 85 years old. This resulted in a 26% increase in cornea donors between 2011 and 2013 (on average 1610 donors per year) compared to 2009 (1276 donors) (NTS 2013). In 2016 the NTS changed the maximum age of heart valve donation from 60 to 65 years for men and 65 to 70 years for women. For bone/tendon donors the maximum age was changed from 55 to 65 years. This resulted in an 8% increase in heart valve donors and a 52% increase in bone-/tendon donors in the years 2017–2018 compared to the year 2015 (NTS 2018). In 2018 the NTS removed bacterial sepsis as a contra-indication for cornea donation. That year the number of donors of whom corneas were released for transplantation increased 62% compared to the year 2017. Removal of bacterial sepsis was responsible for 39% of this change. It resulted in a 19% increase of cornea transplantations compared to 2017 and an increase of corneas exported to other countries. The waiting list is not only defined by the number of cornea tissue donations, but also limited by retrieving, processing and transplanting capacity. In the Netherlands, cornea tissues can be stored in a warm culture for a maximum of 4 weeks. If transplant capacity in the Netherlands is limited, post mortem tissue banks do have the possibility to export to other countries. Supply and demand of corneas should be

optimized nationally and internationally to prevent cornea tissues being discarded.

In conclusion, the nationwide approach in post mortem tissue donation has resulted in sufficient tissue donors to cover the national needs for tissue transplants. The NTS will continue to work together with its partners for an even more effective way to help patients on the waiting list for a transplantation, hereby improving quality of life for every recipient.

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**Compliance with ethical standards**

**Conflict of interest** The authors declare that they have no conflict of interest.

## References

- CBS (Statistics Netherlands) (2012) Attitudes to organ donation and organ acceptance (report in Dutch). <https://www.cbs.nl/nl-nl/achtergrond/2012/15/houdingen-ten-aanzien-van-orgaandonatie-en-organontvangst>. Accessed 7 Feb 2020
- CBS (Statistics Netherlands) (2018) 6.3 million persons in the donor register (in Dutch). <https://www.cbs.nl/nl-nl/nieuws/2018/32/6-3-miljoen-personen-in-donorregister>. Accessed 7 Feb 2020
- CBS Statline (Statistics Netherlands) (2019) Deaths; key figures (in Dutch). "\"/CBS/nl/dataset/37979NED/table?fromstatweb">https://opendata.cbs.nl/statline/"/>"\"/CBS/nl/dataset/37979NED/table?fromstatweb. Accessed 7 Feb 2020
- CBS Statline (Statistics Netherlands) (2019) Deaths; deaths by traffic accident in the Netherlands, manner of participation. (in Dutch). <https://opendata.cbs.nl/statline/#/CBS/nl/dataset/71936ned/table?ts=1581268542600>. Accessed 7 Feb 2020
- EDQM (2019) Newsletter Transplant—International figures on donation and transplantation 2018. <https://www.edqm.eu/en/reports-and-publications>. Accessed 7 Feb 2020
- Figuroa CA, Mesfum ET, Acton NT, Kunst AE (2013) Medical students' knowledge and attitudes toward organ donation: results of a Dutch survey. *Transplant Proc* 45:2093–2097. <https://doi.org/10.1016/j.transproceed.2013.02.135>
- NTS (2013, 2018) NTS Annual Reports 2013, 2018 (in Dutch). <https://www.transplantatiestichting.nl/publicaties-en-naslag/nts-jaarverslagen>. Accessed 7 Feb 2020
- Van Leiden HA, Jansen NE, Haase-Kromwijk BJ, Hoitsma AJ (2010) Higher refusal rates for organ donation among older potential donors in the Netherlands: impact of the donor register and relatives. *Transplantation* 90:677–682. <https://doi.org/10.1097/TP.0b013e3181eb40fe>

van Wonderen MLB, Singerling JB, den Toom MH, Grootendorst DC, de Koster MF, Brumsen C (2018) Improving recognition of potential tissue donors: a quality improvement project by a hospitalist in training in The Hague, The Netherlands. *Cell Tissue Bank* 19:777–782. <https://doi.org/10.1007/s10561-018-9733-y>

Vorstius Kruijff PE, Jansen NE, Muijtens BS, Blok-Singerling JG, Tecklenburg BD, de Vos ML, Slappendel R (2014) Are

all tissue donors recognized? A cohort study in three Dutch hospitals. *Cell Tissue Bank* 15:483–490. <https://doi.org/10.1007/s10561-013-9418-5>

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