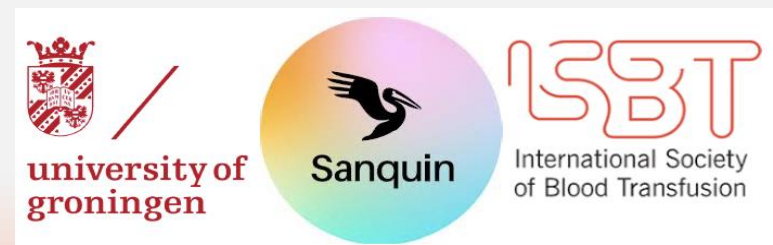


THE NETHERLANDS KINGDOM: SUPPLYING BLOOD WHERE NEEDED

W Martin Smid
MD PhD MBA
Treasurer ISBT
Director Academic Institute IDTM
Managing director Sanquin Consulting Service (retired)



DECLARATION

Nothing to declare

- Treasurer ISBT
- Director Academic Institute IDTM, University of Groningen
- Managing director Sanquin Consulting (retired)



OUTLINE OF PRESENTATION

- Global context
- Netherlands Kingdom blood supply
 - Kingdom
 - Netherlands
 - Caribbean Netherlands
 - St Maarten/St Martin
 - Netherlands Military
 - Solutions: examples elsewhere

Estimated Global Blood Supply

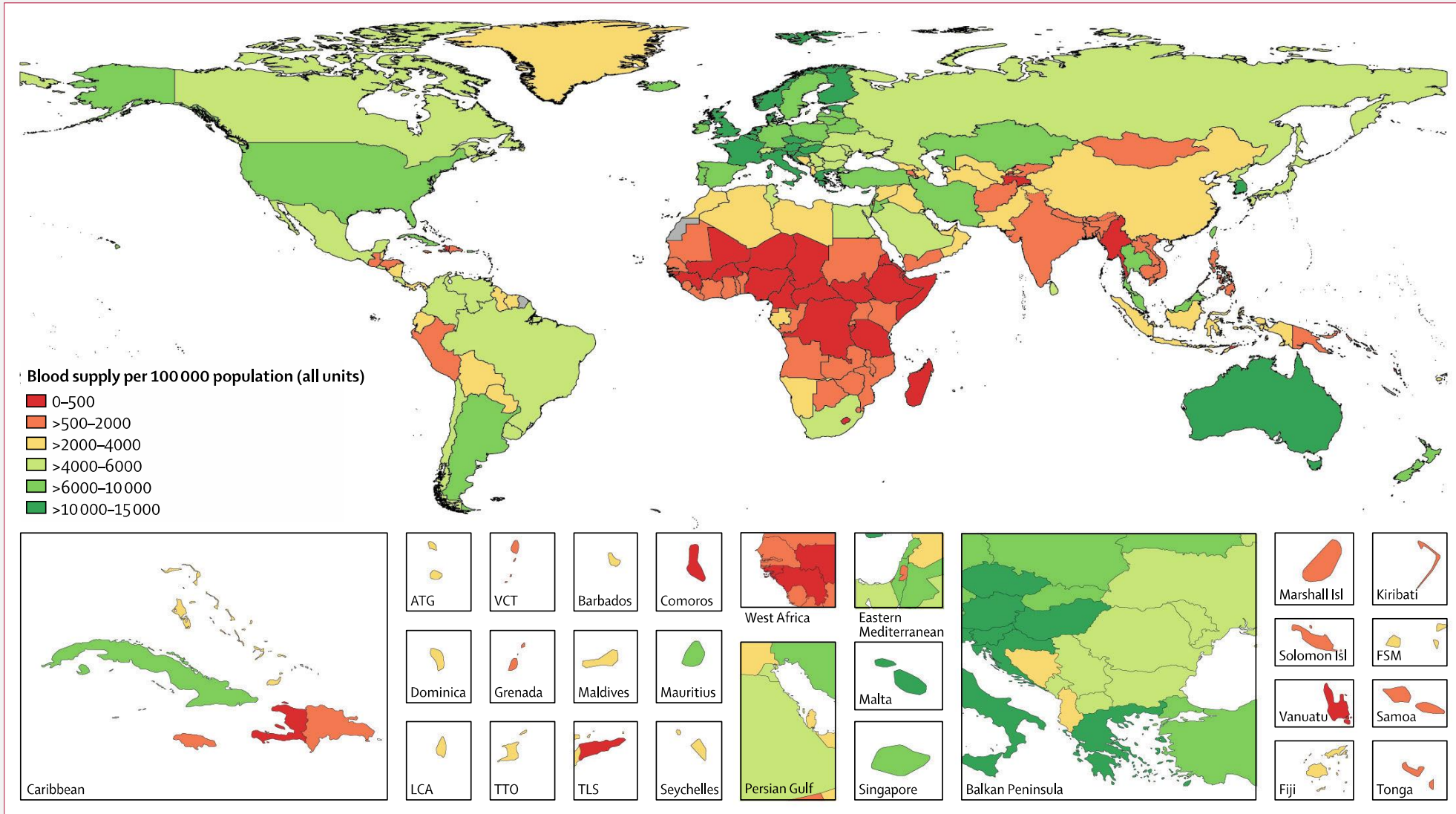


Figure 2: Estimated global blood supply

Estimates are based on WHO Global Status Report on Blood Safety and Availability in 2011, 2012, and 2013. Supply is aggregated over all components. ATG=Antigua and Barbuda. FSM=Federated States of Micronesia. Isl=Islands. LCA=Saint Lucia. TLS=Timor-Leste. TTO=Trinidad and Tobago. VCT=Saint Vincent and the Grenadines.

SITUATION IN EACH COUNTRY OR EVEN REGIONS WITHIN IS DIFFERENT

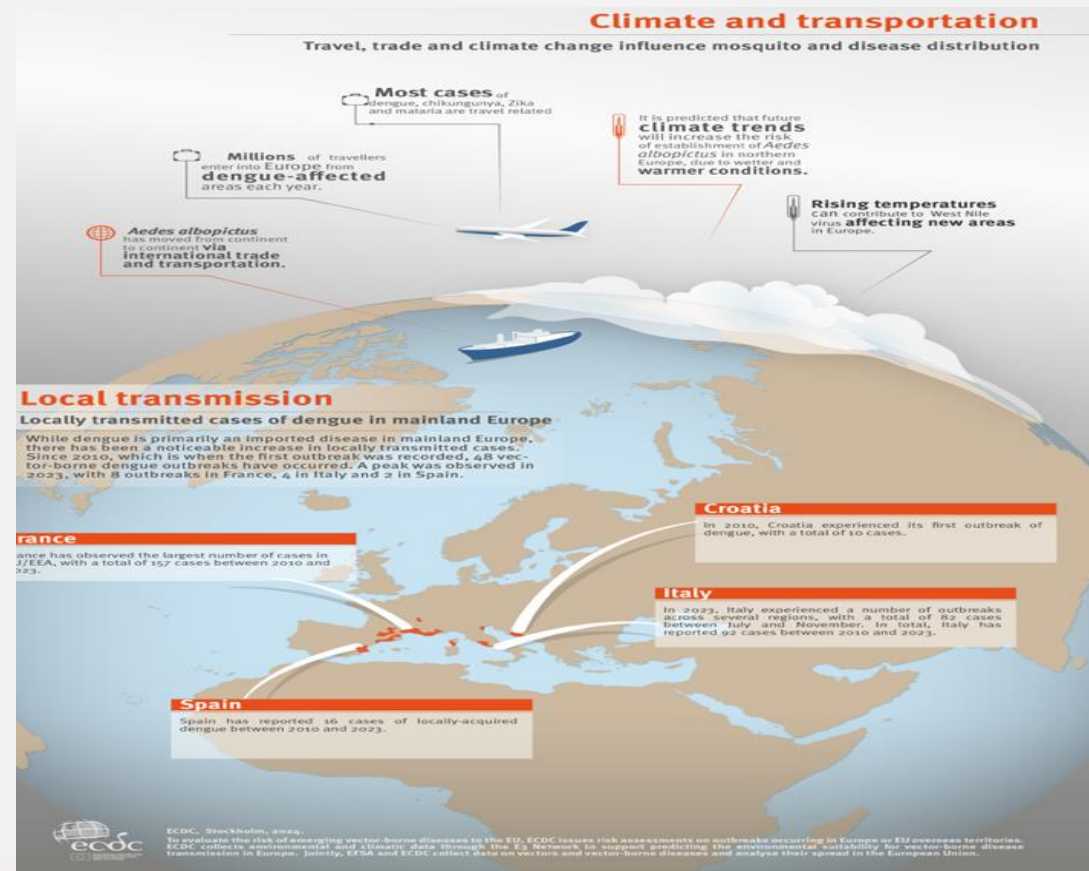
- This asks for **tailor made solutions** and many are in use!
- This presentation will cover the Kingdom of The Netherlands other countries may have other solutions
 - e.g. Lithuania has its blood system and logistics

A ROBUST AND RESILIENT SYSTEM



CHALLENGES FOR DELIVERING BLOOD WHEN AND WHERE NEEDED

- Global Challenges
 - Upcoming Infections
 - Climate change
 - Travel and transport
 - ...
- Plasma for fractionation:
 - Global shortages
- Patients who need blood from donors with rare blood types
 -



NETHERLANDS' KINGDOM: EXPERIENCE



- The Netherlands
- Caribbean Netherlands
- Netherlands Military

KINGDOM OF THE NETHERLANDS

02-10-2025, 13:53

Kingdom_of_the_Netherlands_in_its_region (1).svg



Kingdom of the Netherlands
The Netherlands

The Caribbean part of the Kingdom

Aruba Curaçao Sint Maarten

The Caribbean Netherlands consists of three special municipalities

Bonaire Sint-Eustatius Saba

1 Aruba
2 Curaçao
3 Sint Maarten

4 Bonaire
5 Sint-Eustatius
6 Saba

Puerto Rico

Colombia Venezuela

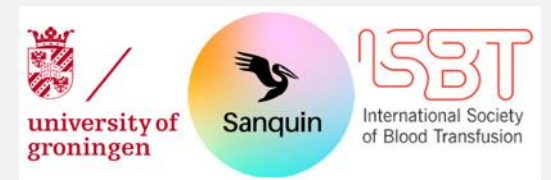
This complex block contains several maps and text. At the top left, it shows the outline of the Netherlands. To its right, under the heading 'The Caribbean part of the Kingdom', are three maps of Aruba, Curaçao, and Sint Maarten. Below these, a text box states 'The Caribbean Netherlands consists of three special municipalities' and lists maps for Bonaire, Sint-Eustatius, and Saba. At the bottom, a larger map shows the Caribbean region with numbered markers (1-6) corresponding to the islands. A legend on the left lists the islands: 1 Aruba, 2 Curaçao, 3 Sint Maarten, 4 Bonaire, 5 Sint-Eustatius, and 6 Saba. Other geographical labels include Puerto Rico, Colombia, and Venezuela.

By TUBS - This vector image includes elements that have been taken or adapted from this file.: CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=15431108>

NETHERLANDS



The country





The The legend of the pelican feeding its chicks with its own blood makes this bird the symbol of mercy.

1925

1943

1998

2022



First Dutch blood transfusion in Rotterdam.



Start of the Central Laboratory of the Blood Transfusion Service (CLB), which is developing through research into the leading knowledge center in the Netherlands in the field of blood, blood transfusions and immunology.



Sanquin founded from the merger of 22 Dutch blood banks and the CLB.



Contribute to a healthy society, with blood, plasma and research as tools for prevention and treatment.

Around **400,000** donors give
750,000 donations per year.

Thanks to these donations,
100,000 patients are treated each
year, with 600,000 transfusions, or
with plasma-derived medicines.

About **2,000 dedicated professionals**
work at Sanquin, including **17 professors**,
80 PhD students and **80 researchers with**
a PhD.

Together they publish about
200 scientific papers per year.

Head office in Amsterdam, distribution
and processing centers at seven
locations in the Netherlands and **130**
locations where blood is donated.



Sanquin uses all components of blood.
These components are not only the basis of life-
saving blood products, but are also essential for
patient diagnostic services and scientific research.



BUILDING SANQUIN OVER YEARS

Collection and Donor management
2024 Ambition for 2025

- 35 hybrid centers from 43
- 14000 donors per center
- 2 plasma only centers
- Longer opening 17x 4hours

Less places, longer business hours

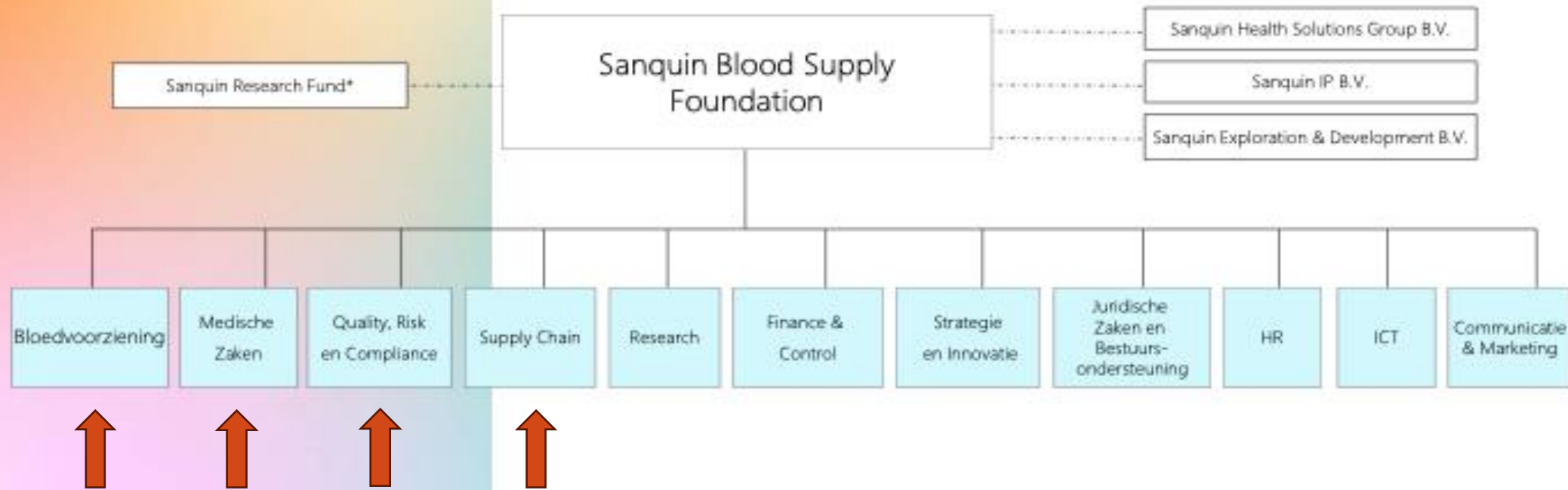
HQ and 2 production sites and 7 distribution sites:

- Quality management
- Medical department
- Supply chain

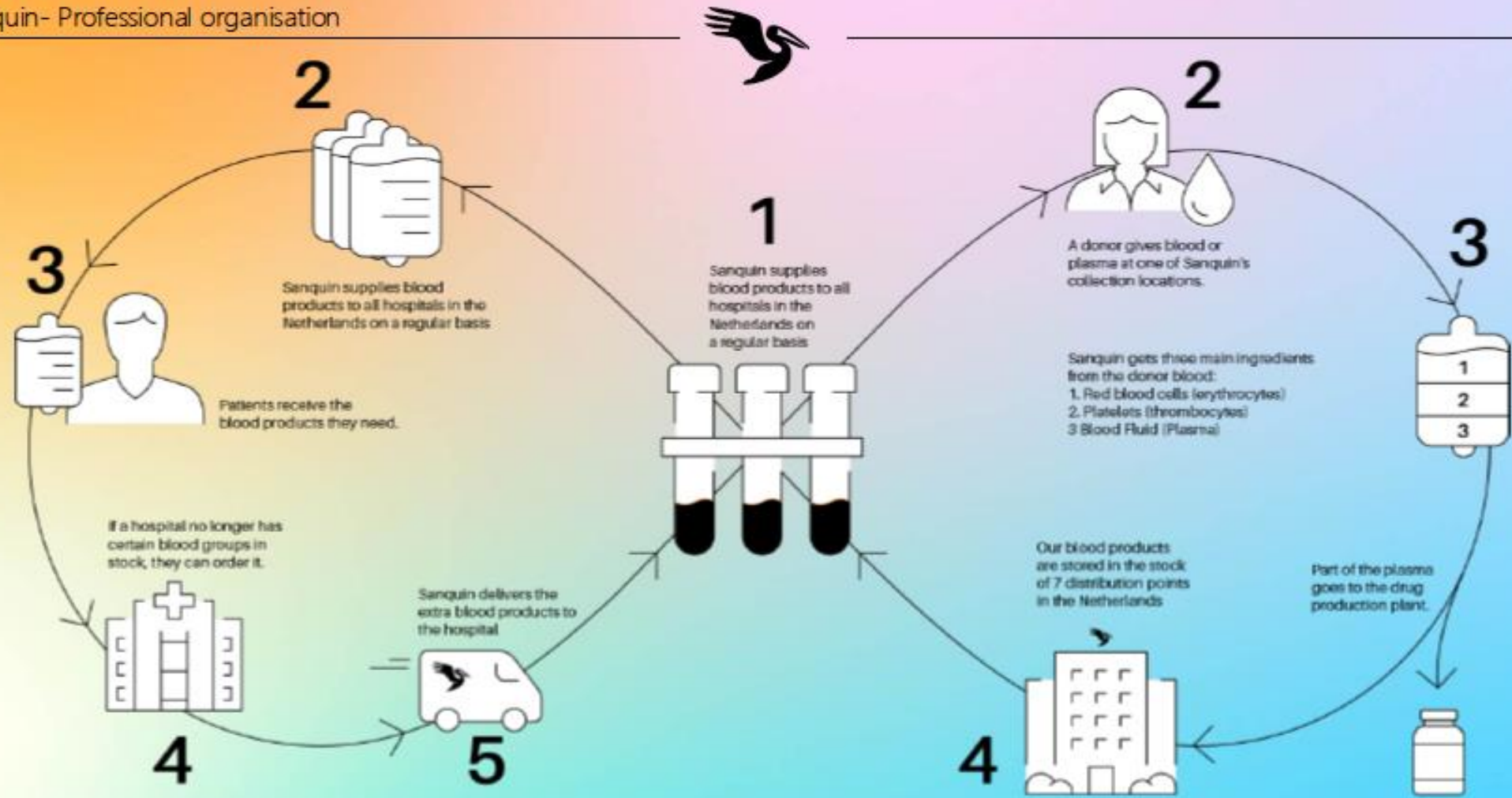




Organization chart



* Sanquin Research Fund is an independent ANBI fund that raises money for research into blood-related disorders.



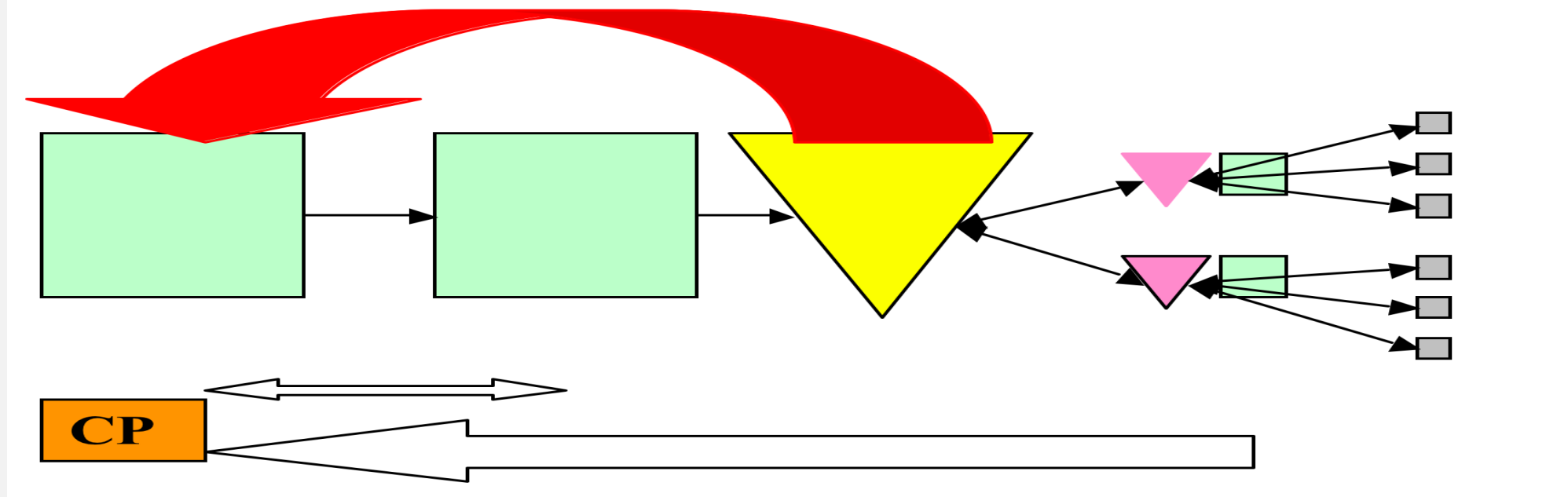
Legal basis

Our legal task is to ensure a sustainable blood supply of labile blood products and the availability of plasma medicines for all Dutch citizens (Wibv).

BLOOD TRANSFUSION CHAIN

Representation of the Blood Transfusion Chain in the Netherlands.
The Big red arrow represents the weekly adaptation of inventory levels.

Donor	Processing	Distribution	Inventory	Wards
Recruitment Retaining Collection	Testing Release	BE Inventory	Hosp n Hosp n+1	Hn, n1,2. Hn+1,...



EMERGENCIES: RECENT DEVELOPMENTS

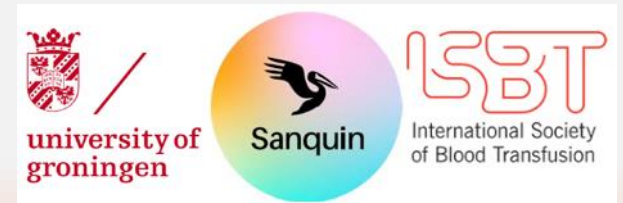


CARIBBEAN NETHERLANDS

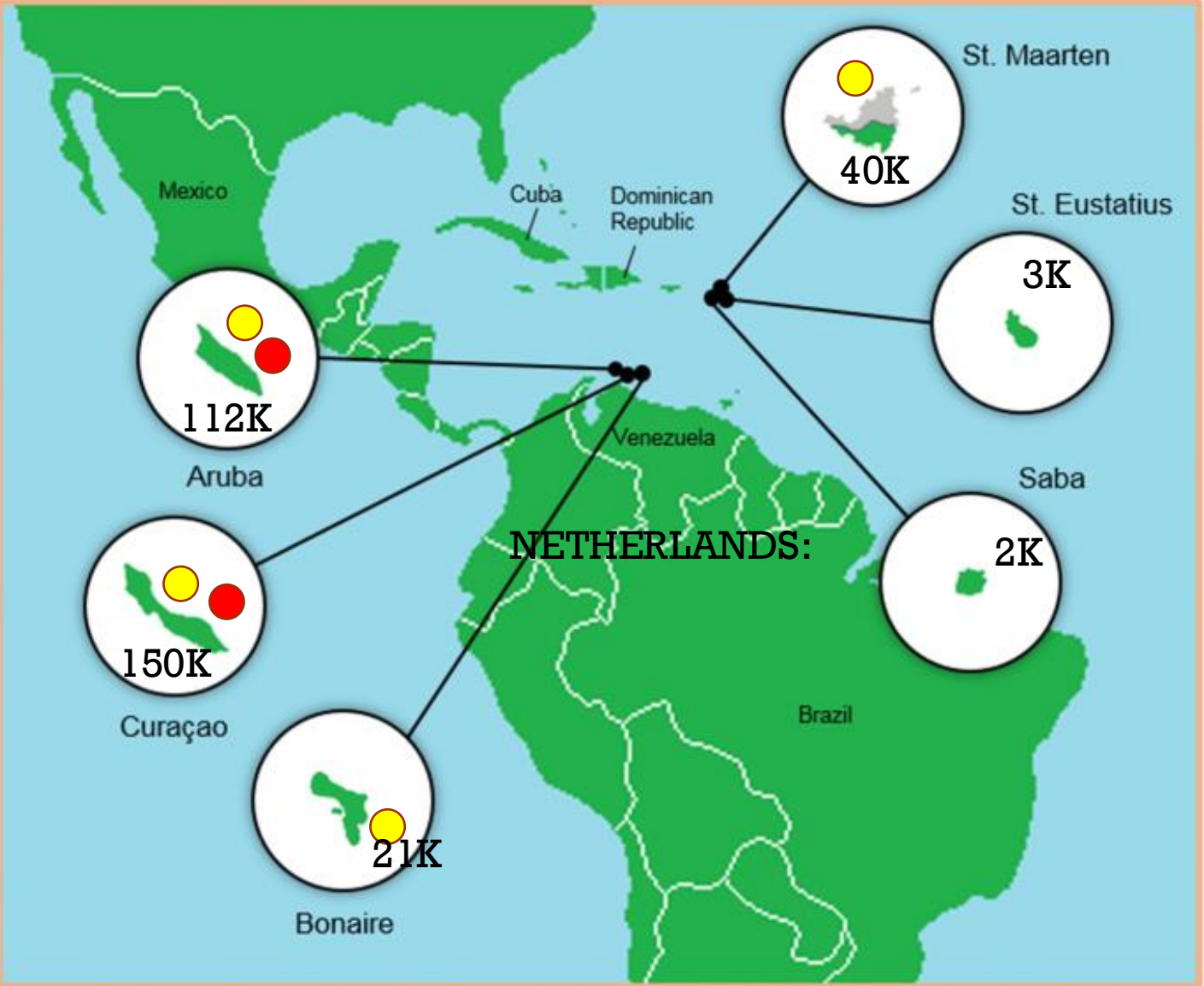


This part of presentation was prepared with:

Prof. dr. A. J. Duits, director of Red Cross Blood Bank Curacao.



CARIBBEAN NETHERLANDS



- Aruba, Curaçao, and St. Maarten are constituent countries of the Kingdom of the Netherlands
- Bonaire, St. Eustatius, and Saba are special municipalities of the Netherlands and EU

● Blood Transfusion Service/Lab (hospital)

● Blood Bank/Donor Center

Supply: daily commercial interinsular flights

SUSTAINABLE AND SELF-SUFFICIENT PROGRAM

OPERATIONS

Red Cross Blood Bank Foundation



DONOR PROGRAM:
BLOOD PRODUCTS:
DONATIONS:
LOCATION:
DONORS:

100% VOLUNTARY NON-REMUNERATED/SELF-SUFFICIENT
RBC (Leukoreduced), FFP, PLATELET CONCENTRATES (PRT)
10.000/year
CURAÇAO (A): 7000 UNITS ARUBA (B): 3000 UNITS
CURAÇAO: 3000 ARUBA: 1500



Regional reference center

Red Cross Blood Bank Foundation



MEDICAL FACILITIES DUTCH CARIBBEAN



300 beds
All specialties including ICU, NICU,
Oncology, HD, Traumacenter



71 beds
All specialties, Oncology,
HD, Traumacenter



320 beds
All specialties,
Oncology, HD, Traumacenter



36 beds
All specialties,
ICU, Oncology, HD

Red Cross Blood Bank Foundation

Table 1 WHO Aide memoire: Quality Systems for Blood Safety [2]

Prerequisites	Nationally coordinated BTS Management commitment and support Integration of quality in the national blood policy National quality policy and plan National quality manager Adequate resources
Organizational management	Clearly defined organizational structure Quality manager in each blood centre and hospital blood bank Quality section in each blood centre and hospital blood bank Culture of quality Commitment and support of all staff Identification of processes and procedures and their critical control points
Standard for Quality Systems	Regulatory or legislative framework Appropriate national or international standards Standards relevant to BTSs
Documentation	Appropriate, comprehensive documents, including a quality manual and standard operating procedures (SOPs) Complete, accurate records System for controlling documents
Training	Training policy and plan Training of all BTS staff in quality and quality systems Training of other healthcare professionals involved in blood transfusion Evaluation of training and its impact
Assessment	Validation Ongoing data collection and analysis Haemovigilance Regular review of all activities Internal and external audits Error management, corrective and preventive action External quality assessment schemes

2008-2020

Quality Program is fundamental

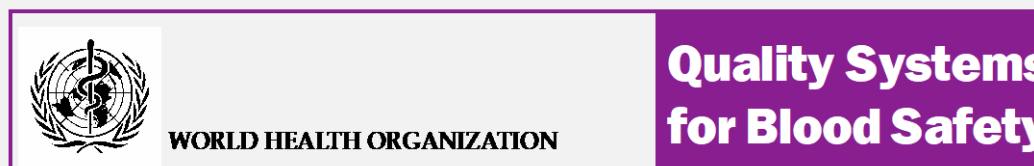
ORIGINAL ARTICLE

Quality Improvement in a small-scale Caribbean Blood Bank: the value of long-term collaboration and stepwise process approach

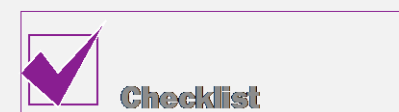
Ashley J. Duits,¹  Luigi Sillé¹ & Willem M. Smid²

¹Red Cross Blood Bank Foundation, Willemstad, Curaçao

²Sanquin Consulting Services and Academic Institute IDTM, Amsterdam, the Netherlands

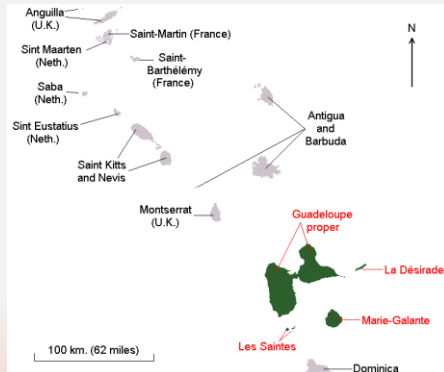


AIDE-MEMOIRE
for National Blood Programmes





**COMPLEXITY
ONE ISLAND
TWO
COUNTRIES**



St Maarten

- Country part of Kingdom of Netherlands
- Blood supplied by Curacao Blood Bank

St Martin

- Part of France (EU) Collectivité de Saint-Martin
- Blood is supplied by EFS (Gouadeloupe)



2017 HURRICANE IRMA 2020 COVID LOCKDOWN



2019 AIRLINE bankrupt

The metaphor of the pelican and the hummingbird:

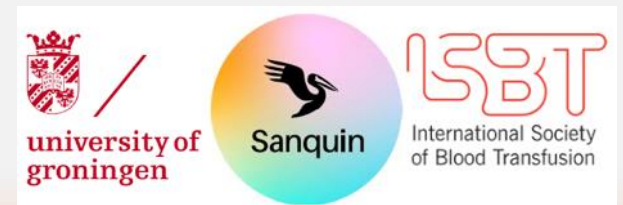
Two birds, each with their own very specific qualities that make them successful in their own environment

As large® scale blood supply organisations (Sanquin) and small-scale blood supply organizations (Curacao and Aruba) with different competencies to be effective



NETHERLANDS MILITARY BLOOD BANK

Slides were prepared from the slides provided by:
Dr. Femke Noorman, Netherlands Military Blood Bank
Ministry of Defence Support Command



Military blood supply:

- How to get the right amount, type and quality of blood products at the right time in remote areas?



WHY MILITARY BLOOD SUPPLY?

- Exsanguinating (uncontrolled) hemorrhage is the major cause of death in military conflict operations:
 - up to 60% mortality rate
 - death occurs within 6 hours
 - majority is preventable
- **if safe blood products are available**



WHOLE BLOOD DONATIONS

WHOLE BLOOD

- **Donations at home?**
 - Short storage time, logistics?
 - Large stock & lot of spillage?
- **Walking blood bank?**
 - Donor availability?
 - Donor and patient safety?
 - Blood type and compatibility testing?



LIQUID STORED COMPONENTS

- “Ageing” during storage
- Energy maintenance living cells:
 - Additive solution for nutrients
 - Lower metabolism at 2-6°C
 - Oxygen supply through bag

→ Relative short storage time → logistic challenges!

ADVANTAGE OF -80° C FROZEN COMPONENTS

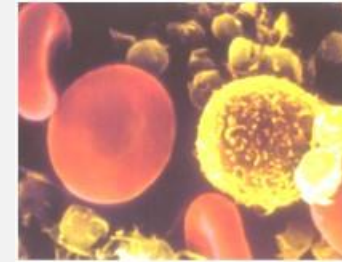
- Platelets 5-7 days +22 °C
- Plasma 2 years - 30 °C
- Red Blood Cells 35 days + 4 °C

- Platelets **4 years** - 80 °C (*)
- Plasma **14 years** - 80 °C (**)
- Red Blood Cells **30 years** - 80 °C (***)

* + 6 hrs at +22 °C after thawing / mixing

** + 14 days at +4 °C after thawing

*** + 14 days at +4 °C after sterile thawing and washing



Long storage time vs cold chain challenges

CRYOPRESERVED BLOOD PRODUCTS

- Freezing damage → anti-freeze
- Thaw/wash damage → procedures
- Recrystallization → temperature <math>< -65^{\circ}\text{C}</math>

- No “ageing” during frozen storage
- Ageing during storage after thaw → additive solution



PRODUCTION DEEP FROZEN ERYTHROCYTES (DEC) -80°C AND THE THAWING

FREEZING ==> DEC

Removal of supernatant;
addition of glycerol, removal
excess glycerol, labelling,
freeze-store at -80°C

THAWING → Thawed DEC

After thaw (± 35 min); removal of
glycerol with ACP215, labelling,
storage (14 days 4°C).
(ACP215 1h: Max 5 units/8 hours)

PRODUCTION OF DEEP FROZEN TROMBOCYTE CONCENTRATES (DTC)

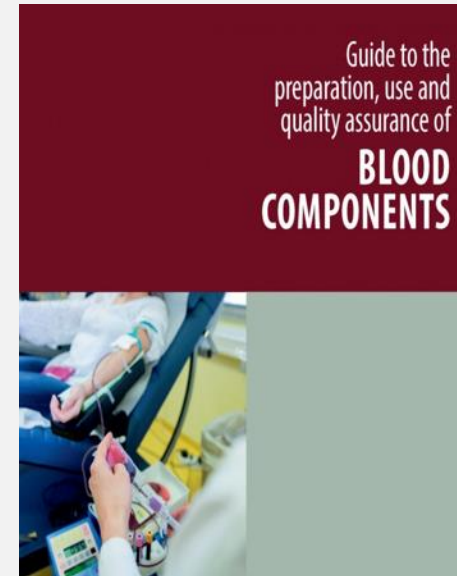
Apheresis platelets are frozen concentrated in ± 15 ml plasma with $\pm 5\%$ DMSO within 24 hours from donation

PRODUCTION THAWED DTC (IN AB PLASMA)

Thawing of plasma (30min) and platelets (5min), label (45 min);
stored thawed platelets (15min)

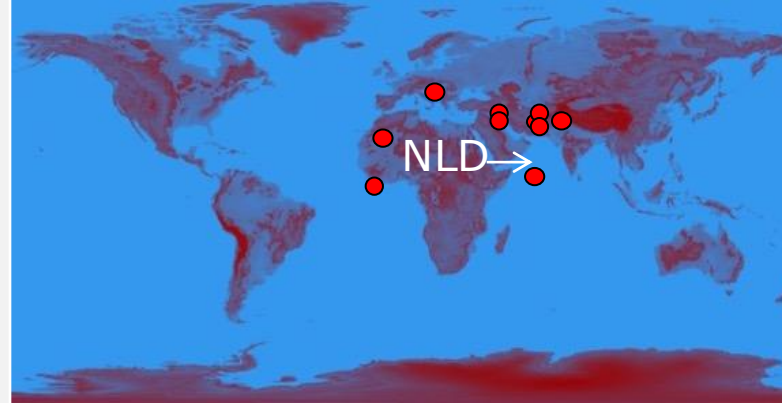
THAWED PLATELETS ARE COMPLIANT TO EU GUIDE

- **>90% of thawed products within criteria:**
 - **1) Platelet content ($>200 \times 10^9$)**
 - Thawed products: **98.3%** $>200 \times 10^9$ plt/Unit
 - Median content **303×10^9** plt/Unit
 - **2) Platelet recovery ($>50\%$)**
 - Fresh-thaw recovery platelets
 - **98.1%** thawed products $>50\%$ (median **68%**)
 - Freeze-thaw recovery platelets
 - **99.7%** thawed products $>50\%$ (median **74%**)
- **N=1724 units**



Noorman et al.
Transfusion. 2023 Jan;63(1):203-216

STORAGE AND TRANSPORT BELOW -65°C



- **Max 7-10 days transport: insulated box with dry ice**

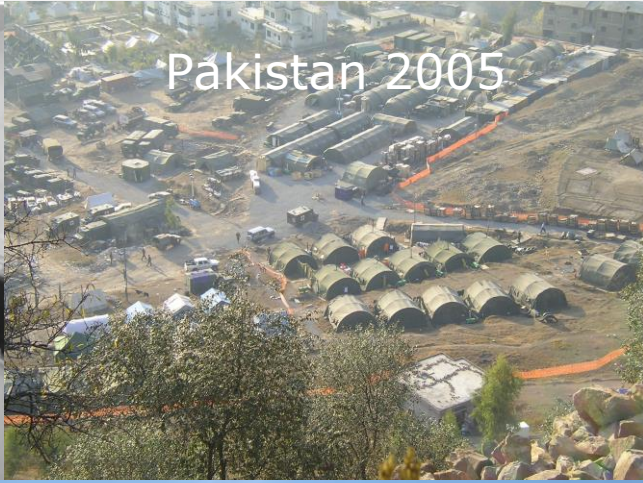


PERIPHERAL BLOOD BANK

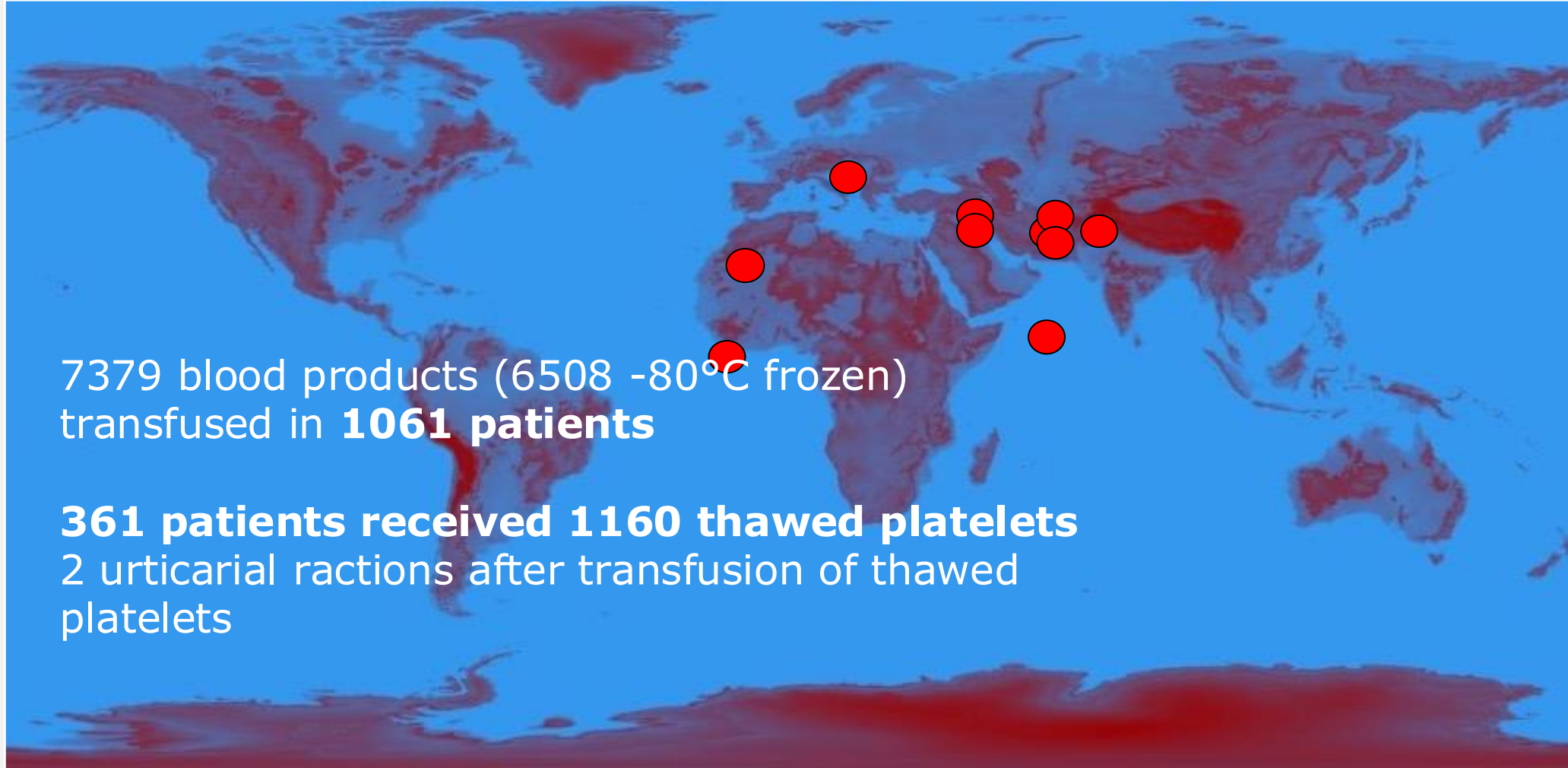


- Required equipment: ACP, waterbath, scale, docking device, sealer, infra-red thermometer, refrigerator, -80°C freezer, CO2 back-up, temp control monitors.
- Stock with disposables for ACP and Docking device

PERIPHERAL BLOOD BANK



CLINICAL USE OF NLD FROZEN BLOOD PRODUCTS 2001-2023



TARIN KOWT AFGHANISTAN 2006-2010



TRANSFUSION: -80°C FROZEN BLOOD PRODUCTS ARE SAFE AND EFFECTIVE IN MILITARY CASUALTY CARE



Tarin Kowt Afghanistan 2006-2010

272 trauma patients (9.9% of total)
needed at least **1 RBC** transfusion

- Introduction of 4:3:1 MTP (Nov 2007) and **4°C stored thawed plasma** (Apr 2009)

Noorman F, van Dongen TT, Plat MJ, Badloe JF,
Hess JR, Hoencamp R. PLOS one 13th dec **2016**

REMOTE NORTH NORWAY

Nokblod

The Civilian Walking Blood Bank project – Northern Norway

Commissioned by the Ministry of Health to The Northern Norway Regional Health Authority

Aim of project: Develop systems to ensure adequate access to blood and blood products

The self-sufficiency principle: Decentralized system for the provision of blood and blood components

Project participants:

Local hospitals

- Longyearbyen
- Hammerfest
- Kirkenes

Air Ambulances

(HEMS and SAR)

- Banak
- Kirkenes
- (Tromsø and Harstad)

Municipalities (primary health care services)

- Alta (20600 inhabitants)
- Nordkapp (3000 inhabitants)
- Berlevåg (970 inhabitants)
- Vadsø (5600 inhabitants)

Norwegian Center for Blood Preparedness (Nokblod)

University Hospital of North Norway Blood Service
Norwegian Armed Forces



Results

Key numbers:

- Number of Civilian Walking Blood Banks established: **4**
- Number of activations per December 2024: **15**
- Number of whole blood bags collected: **31**
- Mean time from activation to blood bag ready for transfusion: **30 minutes**

Indication for transfusion:

- Trauma
- Gastrointestinal (GI) Bleeding
- Re-bleeding after surgical interventions
- Others (suspected aortic aneurism, etc.)

Number of personell trained: **60 (+)**

Number of emergency blood donors: **100 (+)**

Nokblod



RWANDA



From: **WIRED: SIX YEARS AGO**, Rwanda had a blood delivery problem. Over 12 million people live in the small East African country, **sometimes they get into car accidents. New mothers hemorrhage. Anemic children need urgent transfusions.**

These emergencies just *happen*. And when they do, the red stuff stored in Place A has to find its way to a patient in Place B—fast.

NIGERIA

LendAnArm

Our Solution

Host a blood drive

Become a donor

Book a De

Blood Donor Community

Lend an Arm is a holistic blood supply solution. We are committed to increasing voluntary blood donation in Nigeria and delivering good quality blood and blood products to patients in dire need, especially those in rural and otherwise hard-to-reach areas.



Picture Time: <https://time.com/rwanda-drones-zipline/>

<https://www.wired.com/story/drones-have-transformed-blood-delivery-in-rwanda/>

CONCLUSIONS

Deliver blood everywhere

- Sufficient and safe blood everywhere starts with a robust and resilient blood system (WHO, EU)
- Each country is different
- Tailor made solutions are key
- Example of the Kingdom of the Netherlands
 - Large scale vs small scale
 - Logistical challenges and emergencies
 - Challenging military logistics
 - Various legal systems
- Various other examples for tailor made solutions



THANK YOU

Blood donors everywhere

Prof A. J. Duits

Dr F. Noorman

Colleagues

ISBT & Organizers of this
conference

