Ref. Ares(2023)8682240 - 18/12/2023

C/o BLSI Clos Chapelle-aux-Champs 30 – box 1.30.30 B-1200 Brussels Belgium
Phone +32 2 8806216 - info@ supply-project.euwww.supply-project.eu

SUPPLY PROJECT

"Strengthening voluntary non-renumerated plasma collection capacity in Europe"

REPORT ON THE RESULTS OF WP3-D3.1

Plasma

Collection Recommendations

and Support Tool

Authors: Vanaudenaerde Dominiek, Director CPD, Red Cross-Flanders (Belgium)
Stroobants Filip, Supply Chain Manager CPD, Red Cross-Flanders (Belgium)

Version122023_V1

Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project, funded by the European Union's EU4Health Programme (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European Commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union. The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

I. Table of contents

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

Summary

Plasma is a crucial raw material for many medicines and treatments. However, collecting enough plasma to provide patients with plasma-derived medicines (PDMP) within Europe has many challenges. The aim is to strengthen the resilience of plasma collection in the EU to enable a stable and sufficient supply of plasma-derived medicines in Europe.

Blood Establishments (BEs) face significant challenges in their efforts to support the EU's target of strategic independence, particularly when it comes to meeting demand and needs in both national and international markets."

To increase their capacity, they should consider expanding existing donor centres or establishing new ones. However, the crucial factor in this decision is the thoughtful consideration of the donors, who selflessly contribute a part of themselves to help others.

Selecting the optimal location for a plasma donation centre becomes critical for blood establishments that want to contribute to strategic independence in plasma supply. This report proposes a comprehensive approach that includes data analysis, implementation of algorithms, and stakeholder involvement to determine the most appropriate location for a new plasma (or hybrid) donation centre.

By considering factors such as demographic analysis, accessibility, geographic coverage, operational efficiencies, safety considerations, cost analysis, and regulatory compliance, blood facilities can strategically meet national plasma needs and improve the overall plasma collection process.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

2. Step-by-step plan

Establishing an optimal plasma donation centre location is a complex challenge that requires a systematic and iterative (building, refining and improving the process/plan) approach. To achieve this, blood establishments must bridge the gap between strategic planning, tactical decision-making, and operational implementation. A three-step approach, which includes strategic, tactical, and operational aspects, lays the foundation for a successful plasma donation centre. This article proposes to integrate the three-step approach with the Plan-Do-Check-Act (PDCA) cycle, a proven methodology for continuous improvement and decision-making.

The three-step approach starts with a strategic assessment of plasma and blood derivatives needs, taking into account

- government requirements,
- legal obligations
- and international standards.

In addition, an in-depth SWOT analysis assesses donor definition, demographics, and geographic distribution using big data and advanced analytics. The outcome of these strategic evaluations leads to the crucial decision to expand an existing centre or establish a new plasma donation centre.

Then, in the tactical phase, a business case is formulated based on the chosen option. Parameters such as investment, budget and the radius strategy (a formula-driven approach, detailed below) are used to determine the new location. This tactical step ensures that the chosen site is in line with strategic principles and optimises collection efficiency by filling gaps in plasma supply coverage.

Finally, the operational phase brings the chosen plan to life. It includes setting up facilities, training staff, and implementing procedures. Operational success is assessed by monitoring key performance indicators (KPIs), including plasma collection volumes, donor retention rates, and overall operational efficiency as for example “number of donations/FTE, bed occupancy, waiting lines/times,…

While the three-step approach lays the groundwork for the establishment of a plasma donation centre, the PDCA cycle takes it a step further by promoting continuous improvement and adaptability.

2.1. The PDCA cycle

The PDA cycle includes four different steps: Plan, Do, Check, and Act.

- Plan involves thorough preparation and strategic decision-making,
- Do translates these plans into action,
- Check assesses results and performance against the set goals,
- Act implements corrective actions and improvements based on the evaluation.

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

1. Plan:
   - Identify the strategic principles that drive the need for plasma and blood-derived products. This includes understanding government mandates, regulatory requirements, international regulations, and the future demands of the healthcare landscape. Establish clear objectives and goals for the new plasma donation centre.
   - Conduct a thorough SWOT analysis to identify strengths, weaknesses, opportunities, and threats related to plasma donor definition, target audience (example SWOT on page 7), demographics, and geographic distribution. Use big data and advanced analytics (advanced analytics is a collection of data analytics techniques, such as machine learning and predictive modelling, used to improve decisions ...) to gain insights into potential donor pools and underserved regions.

2. Do:
   - Based on the SWOT analysis and strategic principles, determine whether an existing centre should be expanded or a new centre established. Take into account factors such as existing capacity, accessibility and growth potential. Develop a radius strategy formula (see page 8) to evaluate potential locations based on multiple parameters and priorities, including investment, budget, and proximity to target regions.
   - Develop a comprehensive business case for the chosen option, outlining its financial viability, expected plasma collection volumes, operational costs, return on investment, and potential strategic impact. Involve stakeholders, including financial experts and industry consultants, to validate the business case.

3. Check:
   - Once the business case is approved, the optimal location for the plasma donation centre will be selected based on the results of the radius strategy and an evaluation/discussion with local expert team. Consider the identified geographic gaps in plasma collection and potential donor pool in the selected area. Ensure that the chosen location is in line with safety and regulatory compliance.
   - Start with the construction and furnishing of the new plasma donation centre. Contact contractors, architects, and medical equipment suppliers to ensure a smooth installation. Develop a detailed operational start-up plan, including staff recruitment, training, and procedures.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

4. Act:
    - After the new centre is up and running, establish Key Performance Indicators (KPIs) to measure its success. Monitor plasma collection volumes, donor retention rates, operational efficiency, and donor satisfaction. Continuously track and analyse data to identify areas for improvement.
    - Carry out periodic evaluations to assess the Centre's performance against its strategic principles and objectives. Identify opportunities for continuous improvement and implement corrective actions as needed. Use feedback from donors and employees to improve the overall donation experience and operational efficiency.

5. Cycle:
    - Regularly review the strategic principles that determine the need for plasma and blood-derived products. Analyse changes in care demand, government regulations, and international guidelines. Determine if the centre's capacity is sufficient to meet the required plasma needs or if expansion or additional centres are needed.
    - Continuous application of the PDCA cycle to refine and optimise the operation of the plasma donation centre. Regularly update the SWOT analysis and adjust the radius strategy formula based on new data and changing conditions.

Example of the PDCA cycle which can help blood establishments to set up an optimal plasma donation centre that strategically matches regional and national needs.

The cycle guarantees a continuous focus on improvement and the ability to adapt to changing requirements, ultimately contributing to the country's or region's self-sufficiency in plasma supply and overall healthcare preparedness.

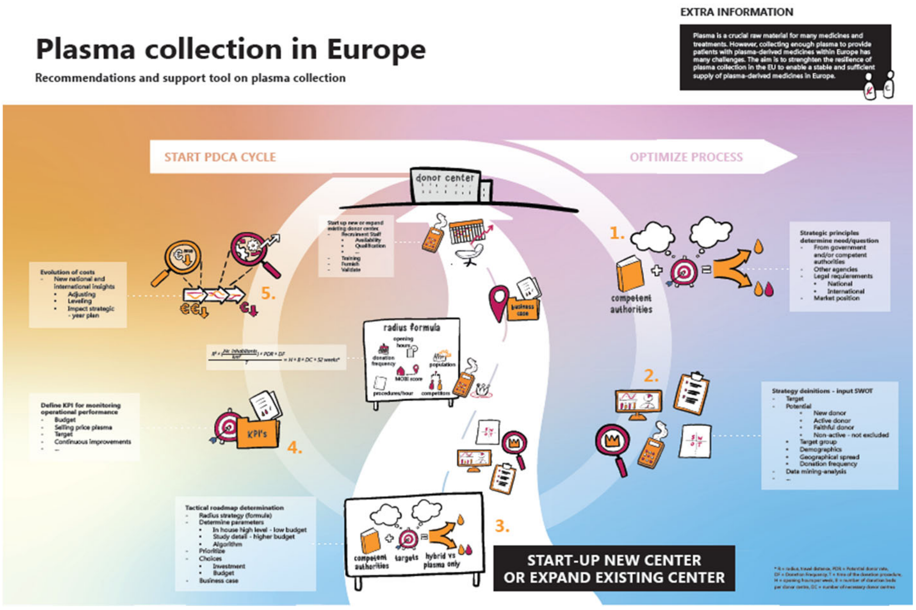


Figure :
PDCA Cycle and Process Flow
(see APPENDIX 3 for larger plan)

Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

***Example SWOT** analysis for determining a target audience for plasma donation.*

INTERNAL FACTORS

STRENGTHS +	WEAKNESSES –
- ***Health-Conscious Individuals:*** *Those who prioritize health and wellness might be motivated to donate for the community's well-being.* - ***Students and Young Adults:*** *This demographic often seeks opportunities to make a positive impact and might be open to donation.* - ***Community-Minded Individuals:*** *People who are actively involved in community service or charitable activities might see donation as a way to contribute.* - ***Regular Blood Donors:*** *Existing blood donors could be easily convinced to donate plasma due to their familiarity with the process.*	- ***Time Constraints:*** *Working professionals might find it challenging to allocate time for donations due to their busy schedules.* - ***Health Issues:*** *Individuals with health conditions or those on medications might be ineligible to donate.* - ***Fear or Discomfort:*** *Some people might be afraid of needles or experience discomfort during donation, deterring them from participating.* - ***Lack of Awareness:*** *Potential donors might not fully understand the importance or process of plasma donation.*

EXTERNAL FACTORS

OPPORTUNITIES +	THREATS —
- ***Educational Institutions:*** *Partnering with universities or colleges can reach young, socially conscious individuals.* - ***Corporate Partnerships:*** *Engage with companies for donation drives or wellness programs.* - ***Online Platforms:*** *Utilize social media and online campaigns to raise awareness and educate potential donors.* - ***Health Events:*** *Participate in health fairs or community events to engage with interested individuals.*	- ***Competing Priorities:*** *People may prioritize other commitments over donation.* - ***Regulatory Constraints:*** *Changes in regulations might affect eligibility criteria for donors.* - ***Negative Perceptions:*** *Misconceptions about donation might dissuade potential donors.* - ***Economic Factors:*** *Financial constraints might limit certain groups from participating in unpaid donations.*

By considering these factors, targeting health-conscious individuals, young adults, community-oriented individuals, and leveraging educational institutions or corporate partnerships could be effective strategies to encourage plasma donation.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

3. Determine the need for a new donor centre.

To secure the need for plasma (now or in the future), it is important to first translate this need into fractions for a systematic approach, taking into account a spectrum of variables, to determine the optimal number of donor centres and their strategic placements. This approach takes into account predetermined plasma needs, characteristics of potential donors, operational constraints, and refined factors to ensure precision and flexibility. This document explains a radius formula where a set of parameters is used/designed.

3.1. Radius formula

3.1.1. Defining the donor base (population):

Start by meticulously defining the characteristics that characterise potential plasma donors, such as age (as decided and prescribed by local, national or international laws), health criteria, suitable veins, personality traits, type of motivation, and other relevant factors. Limit the donor population geographically within a certain travel distance from the potential donor centre and ensure that travel restrictions are taken into account in the assessment. If necessary, shift from geographic/distance radius to travel time constraints when identifying suitable locations. Note that the number of inhabitants also include donors of mobile sites who can be conversed to plasma donors if the mobile drive is within the range of acceptable travel distance/time.

3.1.2. Quantification of donor potential:

Identify and integrate parameters such as population density (number of inhabitants per km²), potential donor rate (or expected/ estimated % habitants who is willing to donate) and expected donation frequency to comprehensively measure the potential donor population. Consider historical data, benchmarking, and the likelihood of no-show cases to refine an estimate of the frequency of donor engagement over time. This includes the incorporation of a filling level so that donor centres do not exceed an optimal capacity (number of beds / slots x opening hours vs staff availability). It is also important to integrate a progressive growth of donor engagement in the business plan. Furthermore, the frequency of donor engagement is becoming increasingly important to address the low engagement during the initial start-up periods, mirroring the gradual growth in donation frequency.

Taking into account both your potential mobile blood site conversion donors and estimating the cannibalisation factor of existing donors from existing donor centres in the radius of the new potential site.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

3.1.3. Estimation of facility requirements with weighted factors:

Improve your estimation of facility requirements by weighing factors that could impact operations. Consider scenarios such as low initial engagement rates when opening new centres and allocate resources accordingly.

3.1.4. Calculation of the number of new donor centres:

Harmonise the dynamic variables – donor bed capacity, procedure time, optimal donor-to-centre ratio, a mobi(lity) score [1] – to determine the optimal number of new donor centres (or expansion of existing ones) needed to meet plasma needs.

To do this, a formula can be defined:

$$\frac{R^2 x \left(\frac{Nr.\,inhabitants}{km^2}\right) x\ PDR\ x\ DF}{T} = Hx\ Bx\ DCx\ 52\ weeks$$

You can either start with the "goal/target " part, calculating the needed potential to meet the goal/target and then fill in with the "where " = location part (benchmark different possible locations , cities, communities, …) to meet the goal/target, or you can start with the "where part" meaning you have some cities/community's in mind of which you can calculate its potential and then fill this in with the "how can we manage " part, meaning the amount of donor centres.

Where part :	***How / What part*** :
R = radius, travel distance	*H = opening hours per week*
*PDR = Potential donor rate**	*B = number of donation beds per donor centre*
*DF = Donation Frequency***	*DC = number of necessary donor centres*
T = time of duration of the donation procedure	*52 weeks or number of opening weeks****

**Potential donor rate (PDR): the blood establishment need to use the potential donor rate if already known (for example 3% within Red Cross Flanders) or need to aim at a minimum of 1% with the population in age depending local regulation.*

***Donation Frequency by type of donor (blood-plasma): note that recruiting a lot of "new" donors shall decrease the frequency rate of the known donors. Donation frequency could be by experience (for example average donation blood = 2 , average donation plasma = 4.5 within Red Cross Flanders).*

**** You can either go for 52 weeks or number of opening weeks, both can be mitigated with a filling rate, for example 80%.*

[1] In Belgium, for example, the Mobiscore calculates the distance from the address to various amenities and access to public transport, etc.

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

Example : Location DC Beringen (last new donorcentre Red Cross Flanders)

We want to open an extra donorcentre to meet the goals /target with an extra potential of

*H = opening hours per week = 50 (5*10) or donation slots*

B = number of donation beds per donor centre = 7

DC = number of necessary donor centres =1

Weeks = 52

RESULT = 50 x 7 x 52 = 18200 possible donations

We have a geographical "gap" in the region of Beringen , does for example Beringen have the needed potential ?

R = radius, travel distance = 15 km (donors are willing to travel 15 km to donate plasma)

Nr Inhabitants /km2 Beringen = 598 inh./km2

PDR = Potential donor rate = 3%

DF = Donation Frequency = 4.5 (plasma average donations 2023)

T = time of the donation procedure =1h (depending on device and donor, but in this example we take a lead time of 1 hour (45 minutes + finishing)

RESULT = Beringen has 15^2 x 598 x 3% x 4.5 = 18164 potential donations

Conclusion : 18164/18200 = 0.99 or 1 : with 1 donorcentre in Beringen we can realise the needed potential.

3.2. Implementation

3.2.1. Low-level

In situations where the availability of resources, budget, or data is limited, the formula comes into play, along with the comprehensive set of definitions and parameters. This powerful tool allows for quick and efficient reconnaissance of the site. The process involves a thorough search for viable cities or locations that meet the criteria of availability, and then an in-depth analysis is conducted to determine the optimal choice based on the predetermined parameters.

By using a systematic approach, which can be improved by the application of weighted factors to accentuate the significance of specific parameters, the formula facilitates a comprehensive evaluation. A good example of this process is the use of a decision matrix. This matrix serves as a dynamic framework, allowing for a meticulous assessment of each potential site against various criteria.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

Through a step-by-step methodology, the formula allows a rigorous examination of the available options, taking into account both quantitative and qualitative aspects. Performing a meticulous "yes/no" check creates a robust calculation, which ultimately reveals the most favourable location. This data-driven approach, reinforced by the integration of weighted factors, guarantees a well-informed decision-making process.

A decision matrix is a structured tool used to evaluate and prioritize different options or alternatives based on multiple criteria. It involves creating a table where each row represents an option and each column represents a criterion. The decision-maker assigns weights or scores to each criterion to reflect its importance or relevance. Then, for each option, the decision-maker assesses or scores how well it performs on each criterion.

Once all the scores are completed, the decision matrix calculates a total score for each option by multiplying the scores by the corresponding weights and adding them together. This overall score helps in ranking and comparing the options, making it easier to identify the most favourable choice based on the established criteria and their respective importance.

3.2.2. High-level

When all parameters and definitions for the radius formula are set, they can be used to implement a more refined algorithm or method for accurately determining the optimal geographic location for the new centre(s). The following section provides an overview of some of the existing methods that can be used for this purpose.

4. Location Selection Methods

When selecting an optimal location, several methods, approaches, and theories should be considered. Decision-makers must choose locations that not only perform well in the current system state but also remain profitable over the life of the facility, even maid changing environmental factors, changing populations, and evolving market trends. This pursuit of robust facility locations presents a challenging task, with decision-makers having to consider uncertain future events.

The goal behind using location selection methods is to help finding locations that maximise value and minimise costs. Location techniques enable the business to accept or reject the available location alternatives.

To achieve this, decision-makers can use a variety of techniques, such as geographic information systems (GIS) analysis, statistical modelling or predictive analytics.

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

GIS analysis allows them to overlay several layers of data, including demographic information, transportation networks, and competitor locations, to identify potential locations with high accessibility and market potential. Statistical modelling helps predict future population growth and demand patterns, which helps assess long-term viability.

Additionally, the use of predictive analytics can provide valuable insights into market trends, allowing decision-makers to anticipate shifts in consumer preferences and plan accordingly. Additionally, it can take into account potential environmental changes such as climate variability and natural disasters, determine the selected site's resilience to unforeseen challenges.

However, the choice of method is determined not only by the complexity of the task, but also by the available resources and budget. Integrating advanced algorithms can involve significant financial investment and require specialised technical expertise. Decision-makers need to find a harmonious compromise between the required accuracy and the practical feasibility of the chosen approach. In this report, we'll take a closer look at the “location selection methods” used by Red Cross Flanders while also briefly touching on other methods.

In order to achieve the plasma targets, additional donor centres must be set up in Flanders and Brussels. The goal of these donor centres is to attract as many new plasma donors as possible, without cannibalisation from existing donors.

Two types of donor centres are being considered, both of which have a different reach to attract donors,

- semi-fixed donor centre : This location (city, municipality, village, …) is a semi-permanent location whose potential population is not sufficient to open a permanent location, but a location that the Belgian Red Cross Flanders can use weekly or several times a week, with mobile staff and where besides blood also plasma can be donated.
- fixed donor centre : This location (city, municipality, village, …) has a potential population that is sufficient to open a permanent location with regular staff.

By combining the population distribution with the distances between donor centres and the places of residence of their plasma donors, a dynamic model is constructed, which includes the estimated number of new donors for each area of 1 km² in Flanders and Brussels (typically 3% of the population between 18 and 65 years old).

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

Red Cross-Flanders, in collaboration with Ghent University, has applied two methods to determine the optimal location for several new donor centres.

- Linear and quadratic programming [2].
- The branch-and bound algorithm [3].

4.1.1. Linear and quadratic programming

Linear and quadratic programming are mathematical optimization techniques used to solve optimization problems, where the goal is to find the best possible solution from a set of feasible choices, while respecting certain constraints.

Linear programming deals with problems where both the objective function and the constraints are linear. In other words, the relationships between the variables in the objective function and the constraints are proportional and additive.

4.1.2. Branch-and-bound algorithm

The basic idea behind the branch-and-bound algorithm is to break down the problem into smaller sub-problems and examine only those sub-problems that have the potential to yield better solutions than the current best-known solution. Branch-and-bound is used to try out all combinations of locations that might be able to provide a better solution.

The input of the algorithm is the population data, the locations of the existing donor centres, the number of new locations to be found and the reach of the donor centres.

In addition, three parameters are used to control the trade-off between performance and the likelihood of finding suboptimal locations. Finally, the performance and results for different values of the parameters are discussed and analysed.

It is important to note that the effectiveness of the branch-and-bound algorithm depends on the quality of the bounding techniques used and the efficient exploration of the solution space.

For a step-by-step explanation of the Bound-and-branch method or the general form of a Linear programming problem – see APPENDIX 1

[2] Delbecque, R. (2021). Localisation of new donor centres in Flanders to maximise plasma collection. Faculty of Engineering and Architecture, Ghent University

[3] Vermeersch, F. (2021). Optimal locations of donor centres for Red Cross-Flanders using branch-and-bound. Faculty of Engineering and Architecture, Ghent University

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

4.1.3. Result of the two methods based on the same parameters

As mentioned, Red Cross-Flanders, in collaboration with Ghent University, has applied this method to determine the optimal location for several new donor centres.

Addressing the problem involved collecting data to determine the number of potential donors among residents. This included categorizing residents based on their age and their proximity to the nearest donor centre.

Subsequently, an optimization model was formulated using a combination of linear and (quadratically limited) quadratic programming techniques. The flexibility of this model for different geographical areas is achieved by adjusting various parameters. In order to simulate the scenario in Flanders as accurately as possible, a specific set of parameter values is drawn up.

Based on these parameter values, an optimal selection of municipalities is determined to host both new permanent and semi-permanent donor centres. This selection must be in line with the objectives of Red Cross-Flanders and enable the rapid realisation of their objectives. Subsequently, a ranking of priorities is generated based on this outcome, with the aim of achieving the objectives of Red Cross-Flanders more quickly.

4.1.3.1 Linear and quadratic programming

Possible new locations geographically nearly the same result as the branch and bound method

1. *Oostende*
2. *Beringen*
3. *Schoten has a high score(blue spot heatmap)but has a large cannibalisation with DC Edegem*
4. *Heist op den berg*
5. *Oudenaarde (opening 4/1/2025)*

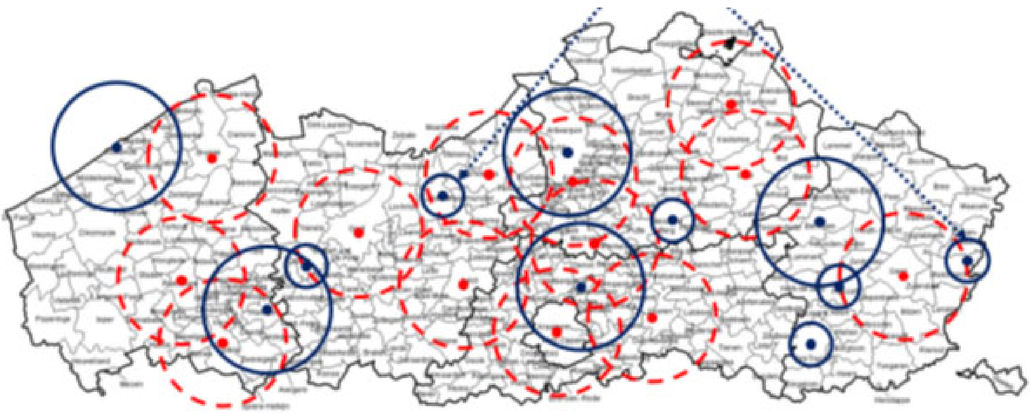


Figure : optimal locations for 5 new fixed donor centres

Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

Result of the branch-and bound algorithm.

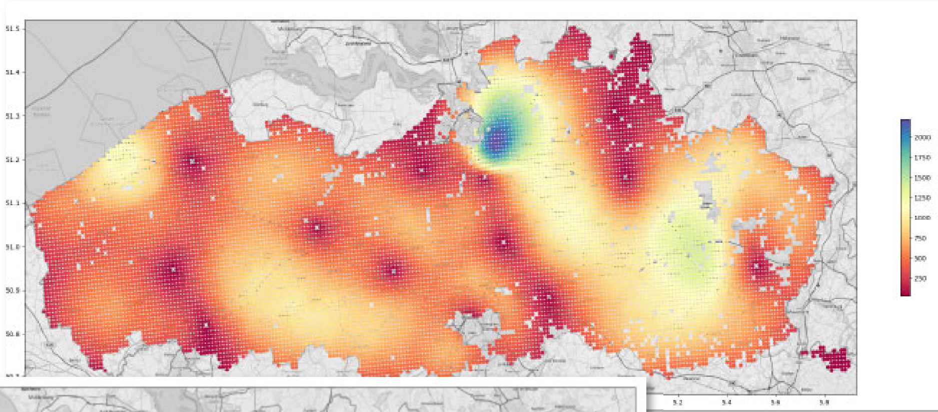


Figure: Heatmap of adapted scores after adding the existing DC's, with a reach of 15 km (top) and 5 km (bottom). *Background maps: © OpenStreetMap contributors.*

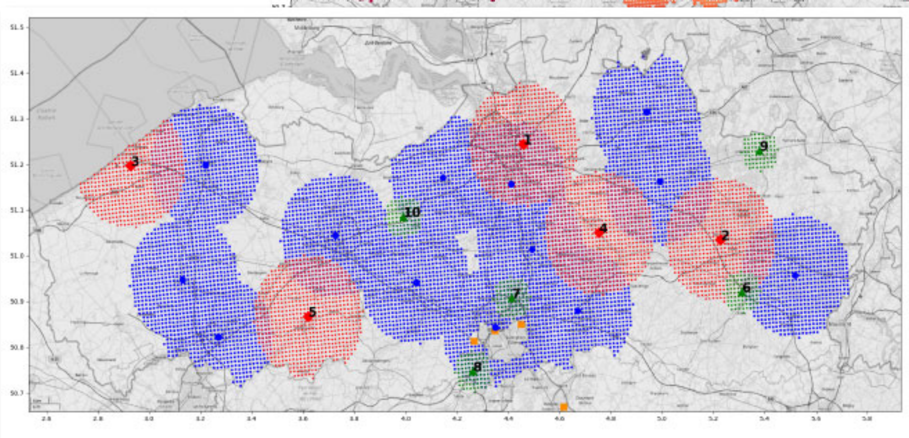


Figure: Results of the branch-and-bound algorithm blue = existing donor centres – red = possible locations for new donor centres *Background maps: © OpenStreetMap contributors.*

4.1.4. Other location selection methods.

4.1.4.1 Best Worse Method

The Best Worst Method (BWM) is a multi-criteria decision-making technique developed by Dr. Jafar Rezaei in 2015.[4] This method serves as a systematic approach to assess a range of alternatives based on a set of decision criteria. By using pairwise comparisons of these criteria, the BWM enables decision-makers to make informed and reliable judgments.

Applying the best worst method in determining the optimal location of the blood centre involves leveraging its strengths to make an informed decision while addressing its limitations through thoughtful customization and the integration of additional methods as needed.

[4] Wikipedia contributors. (2023). Best Worst Method. *Wikipedia*. https://en.wikipedia.org/wiki/Best_worst_method

Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

4.1.4.2. Geographic Information Systems (GIS)

Geographic Information System (GIS) is a powerful and versatile tool used in various fields (for example in marketing, logistics, …) to analyse, visualize, and interpret spatial data. In the context of determining the optimal location for a blood centre, GIS can play a crucial role by integrating geographical, demographic, and facility-related information to make informed decisions.

In conclusion, GIS is a valuable tool that helps decision-makers identify the optimal location for a blood centre by analysing spatial relationships, demographics, and facility-related criteria. It improves decision-making by providing a comprehensive view of geographical factors and enables efficient and effective blood centre operations.

For a step-by-step explanation of the Best Worst Method and a step-by-step explanation using GIS – see APPENDIX 2

5. Start up and monitoring a donorcentre

After exploring different methods for determining the optimal location in the previous chapter, and after the location has been determined, the next steps are careful preparation for the establishment or expansion of the donor centre.

5.1.1. Design and furnishing:

- Whether it's creating a new centre (or expanding an existing one), thorough design and optimal space allocation are crucial. While a new centre provides a blank canvas for a custom design, expansion requires alignment with the existing layout. Efficiently furnishing and equipping the space to accommodate donors, staff, and equipment are equally important considerations.
- **Validation** and compliance : Ensuring compliance with regulatory standards and health guidelines is essential. This includes validating the facility's compliance with quality assurance protocols, safety measures, and regulatory requirements, ensuring a safe environment for both donors and staff.
- **Recruitment of staff and donors:** Recruiting skilled personnel, including healthcare workers and administrative staff, is fundamental. A new centre requires building a skilled team from scratch, while expansion may mean relocating experienced staff. Staff involvement and staff active participation is a key in the target achievement, also change management - taking time to modify some cultures is important. At the same time, devising strategies to attract new donors and retain existing donors is vital for a steady influx of donors.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

- **Training and skills development:** Extensive training of the newly recruited staff is required to ensure a seamless donor experience and streamlined operations. Training in donor care, medical procedures, equipment operation, and emergency protocols is essential to maintain safety and quality standards.
- **Advertising and outreach:** Both new and expanded centres require a strategic approach to advertising and outreach. Building a strong online presence, engaging the community through social media, and partnering with local healthcare providers can help increase donor awareness and participation.

5.1.2. Define operational KPIs

A crucial aspect during this phase is the definition of operational Key Performance Indicators (KPIs) that will guide the assessment of performance and the continuous improvement of the centre's operations.

- **Define operational KPIs** : As part of the planning process, it is imperative to define a set of operational KPIs that will serve as benchmarks for measuring the performance and efficiency of the new or expanded donor centre. These KPIs can include various aspects such as donor retention, frequency of donations, staff productivity, wait times, appointment fulfilment, equipment usage, and overall donor satisfaction.
- **Define change management KPI** : it is also important to set an "Change Adoption Rate (%) " which measures the percentage of employees or stakeholders who have successfully adopted and integrated the changes within a specified period. It reflects the effectiveness of change management strategies in smooth transitions and acceptance within the organization."
- **Aligning KPIs with objectives:** The selected KPIs should align with the objectives and mission of the donor centre. Whether the primary goal is to increase donor participation, improve operational efficiency, or ensure an exceptional donor experience, the KPIs chosen should reflect these priorities.
- **Quantifiable metrics for evaluation:** Operational KPIs should be quantifiable and measurable so that they can be objectively assessed and compared over time. By setting specific numerical goals, the centre can evaluate progress, identify areas for improvement, and make data-driven decisions.
- **Monitoring and continuous improvement:** Regularly monitoring the defined KPIs is essential to accurately measure the centre's performance. Regular reviews of KPI data make it possible to quickly identify trends, bottlenecks, and potential issues. This proactive approach facilitates timely interventions and fosters a culture of continuous improvement.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

- **Customisation and optimisation:** Over time, the operational landscape may evolve, necessitating adjustments to the chosen KPIs. Flexibility in adapting KPIs to changing priorities ensures that performance metrics remain relevant and aligned with the centre's strategic goals.

Defining operational KPIs serves as a compass for the newly established or expanded donor centre and drives activities towards achieving the desired results. By establishing clear performance metrics and monitoring them consistently, healthcare planners and administrators can foster a culture of excellence, drive improvement, and ultimately provide a higher standard of service to donors and the community.

5.1.3. Evolution of costs

In addition to the KPI-based performance appraisal, it is equally important to monitor the evolution of costs. The financial aspects of the operation of the donor centre, including expenses related to staffing, equipment maintenance, facility management, and marketing efforts, should be closely monitored. By analysing cost trends and identifying cost drivers, the centre can optimise resource allocation, manage financial sustainability, and make informed decisions that align with operational efficiency.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

6. Recommendations

6.1.1. Recommendation for the step by step plan

Use a proven methodology for continuous improvement and decision-making like the PDCA cycle.

The PDCA cycle takes it a step further by promoting continuous improvement and adaptability. The PDCA cycle includes four different steps: Plan, Do, Check, and Act.

- Plan involves thorough preparation and strategic decision-making,
- Do translates these plans into action,
- Check assesses results and performance against the set goals,
- Act implements corrective actions and improvements based on the evaluation.

Use SWOT analysis to identify strengths, weaknesses, opportunities, and threats related to plasma donor definition, target audience (example SWOT on page 7), demographics, and geographic distribution

6.1.2. Recommendation to determine the need for a new donorcentre.

To secure the need for plasma (now or in the future), it is important to first translate this need into fractions for a systematic approach, taking into account a spectrum of variables, to determine the optimal number of donor centres and their strategic placements. This approach takes into account predetermined plasma needs, characteristics of potential donors, operational constraints, and refined factors to ensure precision and flexibility.

Make use of the RADIUS formula where a set of parameters is used/designed to have a first high level answer to meet the defined goals/targets before implementing more technical location selection methods .

6.1.3. Recommendation on the use of more technical location selection methods

Apart from the quick approach via the radius formula that can indicate a direction or solution at a high level, it is advisable, for the more technical methods, to collaborate with specialized companies or with universities/colleges that are happy to assign such questions to master theses.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

TAKE A WAY MESSAGE :

Many blood establishments currently choose a location based on intuition, but often take various factors into account, such as population structure, public transport, other collection centres, etc.

While the decision to start a new centre or expand an existing centre to meet the national goals/targets, sets the course, the next steps of design, fit-out, validation, recruitment, training, and advertising contribute significantly to the blood establishment success.

Each stage must be carried out meticulously to ensure a functional, compliant, and well-received donor centre that effectively serves both donors and the broader healthcare ecosystem.

In conclusion, determining an optimal location for a facility requires a comprehensive and forward-looking approach. Decision-makers should consider different methods, consider uncertain future events, and balance available resources and budget.

This report provides different selection methods to use for an appropriate approach to select or choose a new location or expanding an already existing one including a mathematical approach, which is relatively simple, but which requires blood establishments to properly define the parameters.

These recommendations, when integrated with performance appraisal and financial oversight, provide a comprehensive approach that ensures the centre's success in delivering a valuable and sustainable service to both donors and the community.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

APPENDIX 1

4. LOCATION SELECTION METHODS (page 7)

Step-by-step explanation of the Bound-and-branch method or the general form of a Linear programming problem.

4.1.1. Linear and quadratic programming

The general form of a linear programming problem is:

Maximise (or minimise) $c_1x_1 + c_2x_2 + ... + c\,nxn$ Subject to: $A_{11}x_1 + A_{12}x_2 + ... + A_1nxn \leq b_1$ $A_{21}x_1 + A_{22}x_2 + ... + A_2nxn \leq b_2$ ... $Am_1x_1 + Am_2x_2 + ... + Amnxn \leq bm$ $x_1, x_2, ..., xn \geq 0$

Where:

- **C_1, C_2, ..., CN** are coefficients of the objective function.
- **x_1, x_2, ..., xn** are decision variables.
- **A_{11}, A_{12}, ..., Amn** are coefficients of the inequalities in the restriction.
- **B_1, B_2, ..., BM** are the right sides of the limitations.
- The last set of inequalities ensures that the variables are non-negative.

Linear programming has a wide range of applications, including resource allocation, production scheduling, transportation issues, and financial portfolio optimization.

***Quadratic Programming (QP):* Quadratic** programming expands the concept of linear programming by allowing the objective function to contain quadratic terms (e.g., x_1^2, x_2^2) in addition to linear terms. However, the limitations remain linear.

The general form of a quadratic programming problem is:

Minimise (or maximise) 1/2xTQx + cTx Subject to: Ax ≤ w x ≥ 0

Where:

- **Q** is a positive semi-definite matrix representing the quadratic coefficients.
- **C** is a vector of linear coefficients.
- **x** is the vector of decision variables.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

- **A** and **b** represent the linear constraints.

Advantages of Linear Programming:

1. **Efficiency**: Linear programming problems can be solved efficiently using established optimization algorithms, even for large-scale problems.

2. **Applicability**: LP is broadly applicable in a variety of fields, from resource allocation to production planning and supply chain optimization.

3. **Easy interpretation**: The linear nature of LP makes the results easy to interpret and explain to decision-makers.

4. **Optimal Solution**: LP guarantees finding an optimal solution, assuming the problem is well-defined and achievable.

5. **Sensitivity analysis**: LP provides sensitivity analysis so that you can understand how changes in input coefficients affect the optimal solution.

Disadvantages of linear programming:

1. **Assumption of** linearity: LP assumes linearity in both objective function and constraints, which may not accurately model all real-world situations.

2. **Limited expressiveness**: Complex relationships with nonlinear interactions between *variables cannot be modelled directly in LP.*

4.1.2. Branch-and-bound algorithm -

Here's a high-level overview of how the branch-and-bound algorithm works:

1. **Branching:** The algorithm starts with an initial problem and divides it into smaller sub-problems by creating branches. These consequences usually correspond to several choices or decisions that need to be made to solve the problem.
2. **Boundary**: For each sub-problem, an upper and a lower limit of the optimal solution are calculated. The lower limit represents the best possible solution that can be obtained from the current sub-problem, while the upper limit is an estimate of the potential solution quality. If the upper limit of a sub-problem is worse than the current best solution, that branch can be pruned, as it cannot lead to an optimal solution.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

3. **Exploration**: The algorithm explores the sub-problems in a systematic manner, often using strategies such as depth-first or width-first search. It can prioritize exploring sub-problems that have the potential to yield better solutions than the current best-known solution.

4. **Update Best Solution**: As the algorithm explores the solution space, it keeps track of the best solution found so far. If the lower bound of a subproblem is better than the current best solution, the algorithm updates the best solution.

5. **Pruning**: When the upper limit of a sub-problem is worse than the current best solution, that branch is pruned and further exploration for that branch is stopped. This is an important step that allows the algorithm to avoid searching in unpromising directions.

6. **Termination:** The algorithm ends when all possible branches have been explored or when a termination condition has been met (e.g., a certain level of search depth has been reached). The best solution found during the exploration process is then sent back as the final solution.

Advantages of the Bound-and-branch method:

1. **Optimal Solution**: Branch and Bound is guaranteed to find the optimal solution to optimization problems within a feasible solution space. It systematically explores the entire solution space and ensures that no solution is overlooked.
2. **Versatility**: The Branch and Bound method can be applied to a wide range of optimization problems, including combinatorial optimization, (mixed) integer programming, …
3. **Global Optimality**: Unlike some other optimization methods that can find local optics, Branch and Bound is designed to find the global optimum by exhaustively exploring the solution space.
4. **Problem decomposition**: The algorithm breaks down a complex problem into smaller sub-problems, making it easier to manage and solve. Each sub-problem is solved individually, simplifying the overall resolution process.
5. **Optimization Control** : The algorithm provides control over the exploration process through various heuristics, such as strategically selecting branching variables, which can help improve efficiency.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

Disadvantages of the Bound-and-branch method:

1. **Exponential complexity**: In some cases, the Branch and Bound method can have exponential time complexity, especially if the number of possible solutions is large. This can lead to impractical durations for certain issues.
2. **Memory Usage**: Since the algorithm explores multiple branches, it can take a lot of memory to store the solutions and the branching tree, particularly for in-depth exploration.
3. **Branching Strategy** : The efficiency of Branch and Bound can depend heavily on the branching strategy used. Poorly chosen branching variables or strategies can lead to slow convergence or ineffective pruning.
4. **Pruning** challenges: While pruning eliminates unpromising branches, it can be challenging to accurately estimate the upper and lower limits for each sub-problem, potentially leading to suboptimal solutions or overestimates.
5. **Problem-specific formulation**: The success of Branch and Bound can vary depending on the problem formulation. Some problems, by their very nature, do not lend themselves to effective branching and demarcation.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

APPENDIX 2

4.1.4 OTHER LOCATION SELECTION METHODS (page 15)

Step-by-step explanation of the Best Worse method or Geographic Information Systems (GIS).

4.1.4.1. Best Worse Method : The Best Worst Method provides decision-makers with a clear framework for evaluating alternatives in a multi-criteria context. The reliance on structured pairwise equations helps reduce potential inconsistencies and improves the overall robustness of the decision-making process. See more papers -thesis- cases - … on http://www.bestworstmethod.com

1. **Identification of criteria:** The decision-maker (DM) identifies a set of decision criteria that are relevant to the evaluation. These criteria can include various aspects such as cost, feasibility, environmental impact, and more.
2. **Best and worst** criteria: The DM selects two specific criteria from the identified set: the "best" criterion and the "worst" criterion. The best criterion is the most crucial factor influencing the decision, while the worst criterion plays the opposite role.
3. **Pairwise Equations:** Using a predefined numerical scale (e.g., 1 to 9), the DM performs pairwise comparisons. They judge the best criterion against all other criteria, indicating the degree of preference or importance. Similarly, the DM compares all the criteria with the worst criterion, indicating their relative significance.
4. **Optimization problem:** The sets of pairwise equations obtained in step 3 are used as input for an optimization problem. The goal of this optimization is to derive the optimal weights assigned to each criterion. These weights reflect the relative importance of the criteria in influencing the decision.
5. **Weighted evaluation:** The derived weights are then applied to the evaluation of the alternatives. The alternatives are ranked or scored based on how well they perform with respect to the established criteria and the corresponding weights.
6. **Reliable results:** The distinguishing feature of the BWM lies in its structured approach to generating pairwise comparisons, leading to more reliable and consistent results. By explicitly defining the best and worst criteria and using systematic comparisons, the BWM aims to reduce bias and subjectivity in the decision-making process.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

7. **Sensitivity analysis:** As with any decision-making method, it is essential to conduct a sensitivity analysis. This involves assessing how changes in the pairwise equations or criterion weights may affect the final ranking or scores of the alternatives.

When applying this method in the context of determining the optimal location for a blood centre, the following advantages and disadvantages can be distinguished:

Advantages of BWM in determining the location of blood centres:

- **Structured comparisons:** In the context of determining the optimal location of the blood centre, BWM can help compare different potential locations based on specific criteria such as accessibility, population density, and healthcare infrastructure. This structured approach helps in making more informed decisions.
- **Clear priorities:** BWM's identification of the most critical criteria aligns well with the need to prioritise factors such as proximity to hospitals, transportation networks, and population centres, which are critical to effective blood centre operations.
- **Reliable results:** Applying BWM to assess potential blood centre sites allows for a systematic evaluation that minimises potential biases, leading to more reliable insights about the most appropriate location.
- **Quantitative Weights:** BWM's optimization problem can determine the optimal weights for a variety of criteria, providing a quantitative basis for comparing and ranking blood centre alternatives.
- **Simplicity:** The intuitive nature of BWM simplifies the process of comparing different locations based on specific criteria, making it easier for decision-makers to understand and act on the results.
- **Transparency:** BWM's step-by-step process improves transparency in decision-making, which is crucial in choosing the best blood centre location that aligns with healthcare goals and community needs.

Disadvantages of BWM in determining the location of blood centres:

- **Limited complexity:** While BWM helps prioritise criteria, it can oversimplify complex interactions between factors, such as potential synergies between different healthcare settings and regional health needs.
- **Subjectivity:** The initial selection of the best and worst criteria, as well as the assignment of values on the predefined scale, can introduce subjectivity into the decision-making process, which should be carefully considered in the context of the location of the blood centre.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

- **Accuracy of weighing:** Calculating optimal weights may not fully reflect the preferences of decision-makers in the context of the blood centre. For example, some criteria, such as emergency response times, may be more critical than others.
- **Limited applicability:** While BWM is effective for many decision scenarios, it can have limitations in taking into account unique aspects of blood centre surgeries and specialised care requirements.
- **Stakeholder input:** Ensuring that BWM takes into account valuable input from stakeholders, such as local healthcare providers and community representatives, is vital to making well-rounded blood centre location decisions.
- **Scale sensitivity:** Careful consideration of the predefined scale is important to avoid unintentional bias when evaluating the possible locations for blood centres.
- **Complexity in scale:** In cases involving many criteria, alternatives, and stakeholders, the complexity of BWM can increase, making the decision-making process more complicated.

4.1.4.2. Geographic Information Systems (GIS)

Geographic Information System (GIS) is a powerful and versatile tool used in various fields to analyse, visualize, and interpret spatial data.

Using GIS when determining the location of blood centres:

1. **Spatial Data Analysis: GIS** enables the analysis of spatial data such as the distribution of healthcare facilities, population demographics, transportation networks, and existing medical services. These layers of information can be superimposed and analysed to identify areas where the demand for blood services is high and accessibility is optimal.
2. **Location Suitability Analysis:** GIS can perform a location suitability analysis by taking into account various criteria relevant to the operation of blood centres, such as proximity to hospitals, clinics, emergency services, and main roads. By assigning weights to these criteria and analysing their spatial relationships, GIS can identify potential optimal locations.
3. **Demand forecasting:** GIS can model and predict blood demand based on population demographics, healthcare trends, and historical data. By visualizing where potential patients are concentrated, decision-makers can make informed choices about where to locate a blood centre to meet future demand.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.
The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein

4. **Accessibility assessment:** GIS tools can calculate travel times and distances from different areas to potential blood centre locations. This helps evaluate how accessible the centre would be to different segments of the population and ensures a fair distribution of services.
5. **Network analysis:** GIS can optimize routes for blood collection and distribution by taking into account factors such as traffic patterns and emergency response times. This ensures efficient transportation of blood products to and from the centre, minimizing delays and maximizing life-saving potential.
6. **Spatial visualization:** GIS provides visual representations of data through maps and graphs, making it easier for decision-makers to understand the implications of different location options and communicate with stakeholders and the community.
7. **Risk Analysis: GIS** can provide data on environmental factors, disaster-prone areas, and health trends to assess potential risks to the blood centre's operations and help plan disaster preparedness.

Advantages of using GIS:

- **Informed decision-making:** GIS provides a spatial context for decision-making, allowing stakeholders to see patterns and relationships that may not be evident in tabular data alone.
- **Optimized resource allocation** : By identifying areas of greatest need and potential impact, GIS helps optimize resource allocation, including personnel, equipment, and blood products.
- **Stakeholder engagement:** GIS-generated maps and visualizations facilitate effective communication with stakeholders, community members, and local authorities, fostering collaboration and support.
- **Flexibility and adaptability:** GIS can adapt to changing circumstances and additional data sources, allowing decision-makers to adjust their strategies based on changing needs.

Challenges and considerations:

- **Data quality:** Accurate and up-to-date data is crucial for meaningful GIS analysis. Ensuring the accuracy and reliability of data is essential for making good decisions.
- **Expertise:** Effective use of GIS requires skilled personnel who are familiar with spatial analysis techniques and software.
- **Privacy and ethics:** Ethical considerations regarding patient and data privacy must be taken into account when dealing with health and demographic data.

SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project funded by the EU4Health Programme of the European Union (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union.

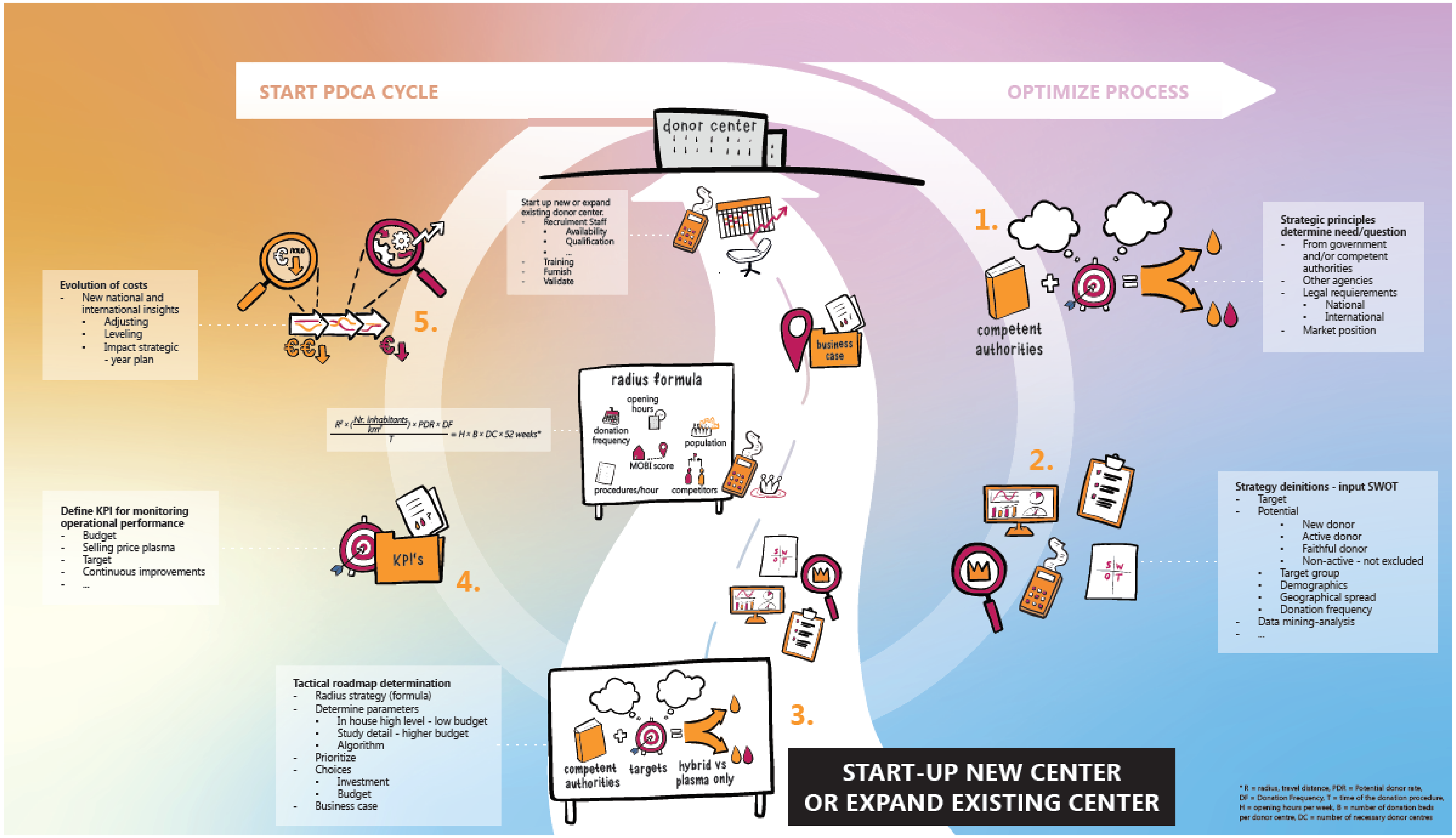
APPENDIX 3

Plasma collection in Europe

Recommendations and support tool on plasma collection

EXTRA INFORMATION

Plasma is a crucial raw material for many medicines and treatments. However, collecting enough plasma to provide patients with plasma-derived medicines within Europe has many challenges. The aim is to strenghten the resilience of plasma collection in the EU to enable a stable and sufficient supply of plasma-derived medicines in Europe.



SUPPLY | Co-funded by the European Union

This report is part of the '101056988/SUPPLY' project, funded by the European Union's EU4Health Programme (2021-2027). The contents of this report represent only the opinion of the author and are his/her own responsibility; it cannot be considered to reflect the views of the European Commission and/or the European Health and Digital Executive Agency (HaDEA) or any other body of the European Union. The European Commission and the Agency do not accept any responsibility for the use that may be made of the information contained therein