TERUMO BLOOD AND CELL TECHNOLOGIES

Unlocking Potential

Predictive Donor Model to Improve Platelet Supply in Response to a Mass Casualty Event

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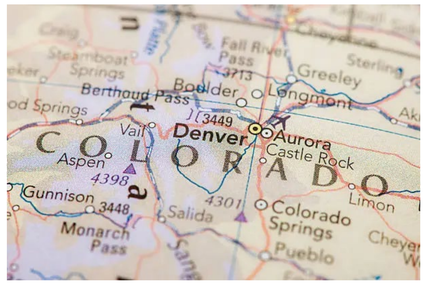
Background

During a mass casualty or nuclear event, the surge in need for blood may exceed the existing supply.[1] Platelets are of particular interest as a large number of platelets is anticipated to be needed in the case of a nuclear event.[1] Apheresis-derived platelets have traditionally been the primary source for platelet transfusions in the United States (U.S.).[2] In a crisis situation, whole blood-derived platelets can be scaled up to supplement the apheresis platelet supply.[3] At least one blood center has modeled its flex capacity to produce platelets in response to crisis situations using an automated whole blood processing system.[3]

Whole blood-derived platelets represent an alternative source of platelets for transfusion.[4] During catastrophic events, people are known to flock to blood centers to donate whole blood.[4] A fully automated whole blood processing system can process whole blood into red blood cells (RBCs), platelets, and plasma. In the U.S., whole blood must be processed within eight hours of collection at room temperature when making platelets.[5] Automated whole blood processing can be scaled up to process large quantities of whole blood units into blood components.[3]



A model was developed to address crisis preparedness based on the location and distribution of donors in a metropolitan area. This model assumes that all blood units collected can be processed in the allotted time. Colorado was selected as a case study with Denver County as the proposed manufacturing site. This model is a logistical framework that estimates populations that would be available as donors and whose blood could then be transported to the theoretical center in Denver for processing. This model facilitates strategic planning for blood collections in the wake of a crisis.

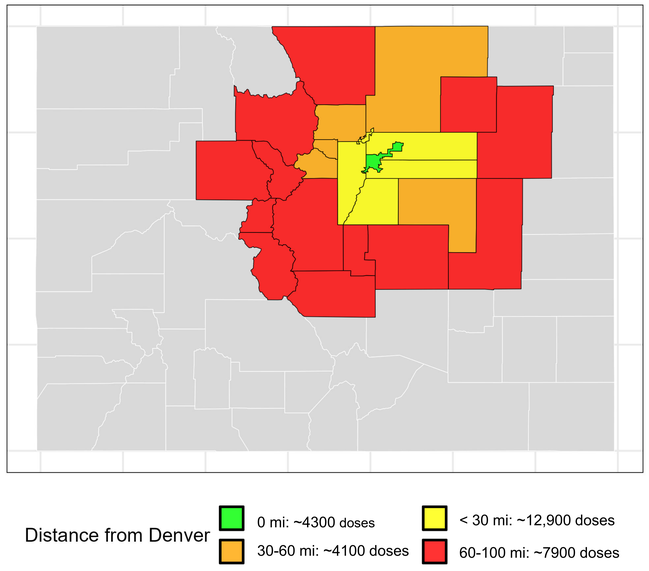
Methods

Colorado's population and mapping coordinate data were acquired from the U.S. Census Bureau.[6] All analyses were performed using R statistical software (v4.1.2; R Core Team 2021) and the ggplot2 package for figures. Distance between Denver County and other Colorado counties was estimated using the R geosphere: Spherical Trigonometry package distGeo function. The distGeo function provides a highly accurate estimate of the shortest distance between two points on an ellipsoid. In this case, the two points were the longitude/latitude values for each county's centroid. The centroid was defined as the center of the county's population. Counties and their populations were included in the analyses if their measured distance fell within the radii range of 0 miles (within Denver County), less than 30 miles, 30 to 60 miles, and 60 to 100 miles of Denver County. The blood donor population was then estimated by multiplying these populations by the typical U.S. blood donor percentage of 3.0%.[7]

In addition to the number of donors, the model also calculated the theoretical number of platelet doses. The number of doses was calculated assuming each transfusable dose consists of a pool of five intermediate platelet units.[3]

Figure 1. Map of Colorado with Estimated Transfusable Platelet Doses

Within 100 miles of Denver: 29.2 K doses (based on a 4.875M population)



Results

There is an approximate population of 146,000 donors, based on a 4.9 million population and the typical 3% donor rate[7] within 100 miles of Denver County. Denver County alone accounts for 21,488 blood donors. Table 1 lists the potential donor population of concentric counties, defined as within a 100-mile radius of Denver, on a county-by-county basis. Table 1 also includes the theoretical number of platelet doses assuming one transfusable platelet dose requires five pooled whole blood platelets. The theoretical number of platelet doses for Denver County is 4,298, and for the 100-mile radius surrounding Denver, it is 29,252.

Figure 1 is a graphic representation of the number of donors and the theoretical number of platelets doses in Denver County and the surrounding counties within a 100-mile radius.

Table 1. Estimated Transfusable Platelet Doses by County
Grouped by Distance from Denver

	County	Distance to Denver	Population	Donors	Platelet Doses
0 miles					
	Denver County	0	716,265	21,488	4,298
<30 miles					
	Arapahoe County	28	651,797	19,554	3,911
	Jefferson County	23	579,392	17,382	3,476
	Adams County	28	511,354	15,341	3,068
	Douglas County	30	342,989	10,290	2,058
	Broomfield County	17	69,324	2,080	416
<60 miles					
	Boulder County	35	324,636	9,739	1,948
	Weld County	60	314,815	9,444	1,889
	Elbert County	52	26,303	789	158
	Clear Creek County	42	9,604	288	58
	Gilpin County	36	6,112	183	37
<100 miles					
	El Paso County	67	712,089	21,363	4,273
	Larimer County	70	350,660	10,520	2,104
	Eagle County	97	54,943	1,648	330
	Fremont County	94	47,959	1,439	288
	Summit County	67	30,817	925	185
	Morgan County	66	28,769	863	173
	Teller County	62	25,113	753	151
	Chaffee County	100	20,041	601	120
	Park County	64	18,525	556	111
	Grand County	72	15,511	465	93
	Lake County	87	7,846	235	47
	Lincoln County	87	5,606	168	34
	Washington County	89	4,888	147	29
Grand Total	—	—	4,875,358	146,261	29,252

Conclusions

- A large number of platelets is anticipated to be needed in the case of a nuclear event,[1] in which case whole blood-derived platelets can be scaled up to meet demand.
- The model developed herein can assist with planning of donor recruitment and blood collection based on distance from a central processing facility. This model can be adapted in other states with large metropolitan areas to better understand donor availability.

References

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Data supporting these analyses are on file at Terumo Blood and Cell Technologies.

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