

REGIONALIZATION AND REGIONAL MANAGEMENT
STRATEGIES FOR THE BLOOD BANKING
SYSTEM: AN OVERVIEW

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ABSTRACT

The issue of regionalization for the blood banking system is considered. A working definition of regionalization is given and the associated economic costs and benefits are discussed. In addition the development of efficient management procedures for a regional blood banking system is also discussed. A report on current research activity in this latter area and future research needs concludes the paper.

INTRODUCTION

The question of centralization of resources, activities and control of health services has become increasingly important with the passage of the National Planning and Health Resources Development Act of 1974. The promulgation of a National Blood Policy by the Secretary of Health, Education and Welfare and the recent (March 1974) founding of the American Blood Commission, a consortium of national organizations representing both the blood services industry and the public sector, has now brought this issue to the attention of the American blood banking community. Consequently, at this crucial time, where long term policy planning questions on the nature of the future structure of the national blood banking system are being asked, there is need for discussion, analysis and rational debate on the basic concept of regionalization. Such discussion must be made in the context of the goals of the blood banking system, the performance criteria to be used in measuring progress in reaching these goals and the constraints imposed by the existing system. Of particular interest in any analysis of the blood banking system will be identification of regionalization policy options, consideration of the rational choice of such options and the possible future impact of these options when they are implemented.

Let us begin our discussion by considering the basic idea of blood bank regionalization. In its broadest sense, regionalization is a process by which a set of blood banks within a given geographical area move towards the coordination of their activities. Such coordination may range from those cases where the blood banks merge into a large centralized unit to those cases where the existing structure is unaltered and certain functions of the region, such as donor recruitment, processing or distribution are carried out cooperatively through information and resource sharing. For the purposes of this paper we will associate the terms region centralization with the first case of coordination and region cooperation with the second case.

A primary goal of this paper will be to stimulate discussion on both the advantages and costs of regionalization. We shall do so by considering some of the economic arguments for and against regionalization. The features required of a model or analytic structure to be used for the provision of definitive answers to this question will also be discussed briefly. In addition we shall consider the question of effective and efficient management control of regional blood bank systems. In particular past work and some preliminary results from ongoing research activity relevant to these issues will be discussed.

Costs and Benefits of Regionalization:

Analysis of the economics of centralized vs. de-centralized control and regionalization has been underway for some time. Application of these ideas to the specific case of the blood banking system has only just begun. It is possible however to identify a number of specific issues in blood banking control which can be affected by the degree of centralization.

A de-centralized mode of operation for the blood banking system can in general lead to a number of costly inefficiencies. For example there may be duplicate or redundant facilities for the processing, storage, transportation and administration of blood and blood products within a given geographical area. In addition each local bank within the area will react individually to local demands. Thus demand for certain rarer blood types or for certain blood products will look highly erratic at the local level. From an aggregate point of view, however, such demands will appear smoother. This is most important since as demonstrated in Cohen and Pierskalla [2], it is random fluctuations in demand along with the re-cycling of released cross-matched units which are the basic causes of both shortages and out-dates in a regional blood banking system.

A further cost of de-centralized control is associated with the set of non-uniform practices which may be adopted in the region. For example the definition of volunteer blood may change from bank to bank. In addition, operating practices may vary. It has also been observed that when different organizational entities become involved in the procurement, processing or distribution of blood products, it becomes difficult to assess the patient an appropriate price for the blood-related goods and services he receives.

Perhaps the most important disadvantage of de-centralized control is the potentially wasteful competition among the banks in the region for the limited supply of donors. This can lead to inefficient scheduling of donor campaigns and drawings which in turn leads to an imbalance of supply within the region.

The above represents a partial list of possible costs for the de-centralized mode of blood bank operation. Regionalization can clearly do much to alleviate these difficulties. It is also clear, however, that regionalization itself will lead to substantial costs. The most obvious of these is associated with the disruption of the existing informal supply network which exists in the country. Any alteration of the existing physical and organizational structure will also increase administrative costs and will act to reduce the degree of local control. Finally, both transportation and information costs will increase substantially

if any management strategy calling for greater coordination, and possible bank re-location is implemented.

A further consideration in the analysis of regionalization is the need to understand in more detail the operating and organizational characteristics of the current system. In particular, those management strategies which do exist and which seem to be effective must be identified, studied and preserved. In this way, through the use of information system technology and efficient management practices, it may be possible to achieve the goals of regionalization without imposing major disruptive changes in the system.

Thus any analysis of regionalization for the national blood system must address itself to the tradeoff between the costs and benefits mentioned above. In particular questions of optimal region size, membership criteria optimal distribution and communication network configurations and bank location must be answered. This procedure involves two steps. The first is the construction of an over-all aggregate model of the national blood banking system. This model could then be used to consider the extent of regionalization in terms of the type of organizational structure which would be most effective in responding to supply and demand imbalances occurring across regional boundaries. This involves the definition of over-all regional boundaries and specification of transportation and communication network links between regions.

The second step of the analytic procedure is concerned with the extension of existing work on models of local and regional blood bank systems. These models can be used to analyze questions of optimal regional blood bank control. The particular policy options which must be considered include:

1. Donor recruitment and procurement policy:

The generation of an adequate blood supply within the region can be achieved if donor drives are scheduled efficiently throughout the region. In addition questions of resource allocation of advertising budgets, scheduling of bleedings, notification procedures for donors on donor lists and the operation of blood insurance and donor club programs must all be answered from a regional point of view.

2. Ordering policy:

Target inventory levels for the local and central banks of the region must be set in an optimal manner. Regional response to seasonality in both blood supply and demand must also be determined.

3. Cross match control policies:

Guidelines at both the local and regional level for the recycling of cross-matched and untransfused units must be set. In addition multiple cross-matching for certain classes of demands may be justified.

4. Component therapy strategies:

Both production and distribution criteria for platelets, plasma and other components are needed at local and regional levels.

5. Transshipment and bank allocation policies:

By shipping blood among banks it is possible to reduce outdates and shortages. Central and local bank structures can be set up to control this process. In addition to defining transshipment rules and procedures, it is necessary to decide upon which local bank will be allocated to the possible central distribution banks in a given region.

We turn next to a discussion of some current work in the area of regional blood bank control.

Regional Blood Bank Management

A number of authors have looked at the problem of efficient management of a local hospital blood bank. Attention has focused primarily on the policy control areas of procurement and donor recruitment, ordering and cross-match return policy rules, and information systems applications to the blood bank. This work is important and ongoing since the peculiar logistical features of a blood bank; random supply, random demand, a highly perishable set of products, the existence of recycling through over-ordering and cross-match releases, control of issuing sequences,

multiple products related by byproduct relationships and a complex multi-level supply, storage and delivery system, all combine to make the analysis and modelling of such systems extremely challenging. A more complete review of this body of literature can be found in [1] and [4]. We will restrict our attention to a number of examples of current research which is directly applicable to the analysis of regional blood bank management.

In [2] we considered a simulation model which could represent either a local hospital blood bank or a regional bank using centralized control over ordering decisions. In addition to examining the interaction of ordering, issuing and cross-match release policies, the model was used to evaluate the effects of centralized vs. de-centralized control over those units issued to local banks and not transfused directly. The response of system outdates and shortages to changes in the degree of centralized control was analyzed. It was shown that many of the gains derived from using optimal issuing and ordering rules could be lost due to increased de-centralization. In [3] a decision rule for the optimal target inventory level as a function of parameters describing the demand process for blood was derived.

In [6], Jennings examines a number of transshipment policies for a regional system consisting of similar sized blood banks. He defined minimum coordination to be the case where each hospital has an independent inventory and maximum coordination to be the case where all inventories are pooled. The degree of centralization is controlled by the amount of transshipment which occurs in the system. It is clear that a policy of complete coordination will have fewer outdates and shortages. It is also clear that this improvement will be achieved with greater communication and transportation costs. Jennings uses a network version of his basic single hospital simulation model [5], to quantify the tradeoff between cost and centralization. In addition he defined a compromise transshipment policy which achieves comparable outdate and shortage savings at a reduced cost.

In [7,8] Yahnke et al have also also investigated various aspects of the regional blood bank. Their work represents one of the first attempts to measure the cost of recycling of blood (due to over-ordering and cross-match release) within the system. In the first paper a data analysis is carried out which illustrates the relationships between outdate probability, blood type and recycling. The results indicate a need for a policy of separate cross-match

periods for different blood types and hospital sizes. In the second paper a mathematical model of recycling in the regional bank is constructed. The model is used to measure the contribution of each member hospital to the total number of outdates for the system. This contribution is related to the recycling or cross-match release policy for each hospital.

At the present time Pierskalla and Yen are analyzing several interesting aspects of regionalization and regional blood bank control. In their model the regional bank is represented by a wheel structure with the central bank at the center of the wheel and the local banks distributed on the rim. Each local bank follows an order policy of the type derived in [3] and places its orders at the central bank. The central bank responds by procuring blood until its inventory has reached a level which can be determined by using a simulation and search procedure. The central bank distributes blood to the local banks in a manner which will equalize the probability of shortage throughout the region. In addition transshipments among banks within the region can be initiated if certain local banks look like they are in danger of excessive outdating. In this way the probability of outdates can also be equalized. The analysis is made more realistic by varying hospital sizes and the number of hospital banks within the region.

The conclusions of this model indicate a number of interesting phenomena. Over a wide range of operating characteristics, little or not transshipment among local banks takes place. This means that each local bank is essentially acting on its own and therefore deals only with the central bank. The response of system averaged outdates and shortages to changes in region size was also evaluated. Not unexpectedly there was an optimal region size which in the cases studied (of more common blood types) ranged from 10 to 15 hospitals. In effect these preliminary results indicate that many of the gains of regionalization can thus be achieved by using relatively smaller systems. Finally it was noted that by using the central bank as a buffer between the overall local demand for blood and the supply of blood, it was possible to have the central bank respond directly to transfused demand only and not to total demand for cross-matched units.

In another current research project Or and Pierskalla are working on the problem of determining optimal regional blood bank network configuration and distribution policies. A large region with several central banks and many local banks is considered. Local banks are allocated to central distributor banks to form regions. The optimal routing of deliveries from the central bank to the local banks in

each region is then determined. This work will provide important insights into rules for both region configuration and management control procedures for a regional bank.¹

Conclusions

The set of models discussed above are directed towards the derivation of optimal operational rules for blood bank management. The question of region formation and inter-region communication must also be looked at with the aid of an aggregate system model. In both cases much work remains to be done. In particular the effect of an increased use of component therapy and the movement towards an all volunteer donor supply must be analyzed. Donor scheduling within a region and the pricing of blood components also remain as important research and operational questions. Finally the problems of supply and the characteristics of use in rural non-metropolitan areas should also be considered.

The future analysis of regionalization and regional blood bank control must be carried out with a view towards providing realistic and supportable policy recommendations. Input on the specification, validation and use of the developing model structures should come from all segments of the blood banking community. In this way the ongoing research activity on the management of blood banking systems will be able to make a positive contribution to the current discussion of regionalization.

1. Information on both current research activities may be obtained by contacting W. P. Pierskalla at the Department of IE/MS, Northwestern University, Evanston Illinois 60201.

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