Blood

Blood Transfusion Services Impact Model
Version 3.0, December 1999

A tool to estimate the impact of interventions to strengthen blood transfusion services

Developed by:

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HIVTools
A cost-effectiveness toolkit for policy makers

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Acknowledgements

The model was field-tested in Zambia, with the assistance of staff at the National Blood Transfusion Services and the National AIDS Control Programme, including Dr. Muyinda and Dr. Roland Musiska

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1. Introduction to *Blood 3.0* and project

1.1 Background

A collaborative research project between UNAIDS and London School of Hygiene and Tropical Medicine, has been working since 1994 to develop methodologies to determine the costs and likely impact of a range HIV prevention strategies - the strengthening of blood transfusion services, the strengthened distribution of condoms, school education, the strengthening of sexually transmitted disease (STD) treatment services, interventions working with sex workers and their clients, and interventions working with injecting drug users.

'*HIVTools*: a cost-effectiveness toolkit for HIV prevention' is currently being developed. *HIVTools* consists of 1) a set of five simulation models that estimate the impact on HIV and STD transmission of different HIV prevention activities, and 2) guidelines for costing different HIV prevention activities. *HIVTools* can be used to estimate the impact, cost and cost-effectiveness of different HIV prevention strategies in different settings.

Blood 3.0 is one of the models within *HIVTools*. It has been developed to estimate the impact of different HIV prevention activities. *Blood 3.0* can be used, within a particular setting, to obtain estimates of the impact of interventions to strengthen the delivery of blood transfusion services. It can also be used to explore what may be the likely impact of different policy options. Estimates of the extent to which the strengthening of blood transfusion services may avert HIV infection among the main recipients of blood products are obtained by comparing the projected number of HIV infections estimated to have occurred in a particular year, if the intervention had not been implemented, with the projected number of HIV infections estimated to have occurred in the presence of the intervention. Comparisons are made using information on the pre and post intervention patterns of blood collection, testing and transfusion.

From conception, the aim was to develop a simple tool that could be used to provide applied intervention specific insights of use to Program Managers and policy makers at the national and local level. For this reason, the structure of *Blood 3.0* has been geared towards using the routine forms of monitoring and evaluation data currently being collected by blood transfusion services. It is hoped that this approach can be used to improve understanding of the impact blood transfusion services, and the potential impact of different forms of possible changes in blood collection, testing and transfusion practice.

1.2 Key features of *Blood 3.0*

- A model of the impact of the strengthening of blood transfusion products that can be used to obtain:
  - Estimates of the number of HIV infections averted and surviving to discharge among under fives
  - Estimates of the number of HIV infections averted and surviving to discharge among women

- Estimates of the number of HIV infections averted and surviving to discharge among men.

- *Blood 3.0* incorporates a range of intervention specific inputs, which enable the user to explore the impact of different forms of intervention activity related to blood collection, testing and transfusion, on the number of HIV infections averted.

- *Blood 3.0* aims to use the forms of epidemiological and intervention process and outcome data that are commonly collected by blood transfusion services.

- *Blood 3.0* is a self-contained piece of computer software, that aims to be sufficiently user-friendly for it to be used by broad range of individuals concerned about the transmission of HIV infection through the provision of infected blood products.

The model considers ways in which an intervention may alter patterns of HIV transmission by:

- Reducing the volume of blood required, (by reducing un-necessary transfusions, or using alternatives to blood products);
- Reduce the prevalence HIV infection in the blood collected – by collecting blood from lower risk donors;
- Increase and improve HIV testing facilities – by possibly increasing the proportion of blood that is HIV tested, and increasing the sensitivity and specificity of the blood transfused;
- Reduce blood wastage – by increasing the flow of blood within the system.

1.3 Development and distribution of *Blood 3.0*

The initial structure of the model developed is the result of a series of consultations with staff at UNAIDS, and following a review of the literature on HIV and blood transfusion services. Simple flow charts were used to describe the initial model structure and underlying assumptions. These were used to enable a range of groups to guide the structure of the model developed.

The model and its underlying assumptions were field tested in Zambia in 1995, in collaboration with the Zambia National Blood Transfusion Services and the Zambia National AIDS Control Programme. Further field-testing will be required to assess the more general applicability of the model, and to refine its' format to the needs of specific users.

Version 3.0 was finalised in February 2000, and can be obtained free of charge from UNAIDS. It is likely that further revisions to the model will be made once further feedback on its use has been obtained. Anyone who would like to receive up-dated copies of the model should write to London School of Hygiene and Tropical Medicine giving their contact details, and describing how they plan to use the model. They will then be sent the latest version of the model and an accompanying manual. Copies of any reports or publications arising from use of the model should be sent to UNAIDS, and to Dr. C. Watts at the London School of Hygiene and Tropical medicine. Feedback on the model would also be greatly appreciated, and will be used to guide the future development of the package.

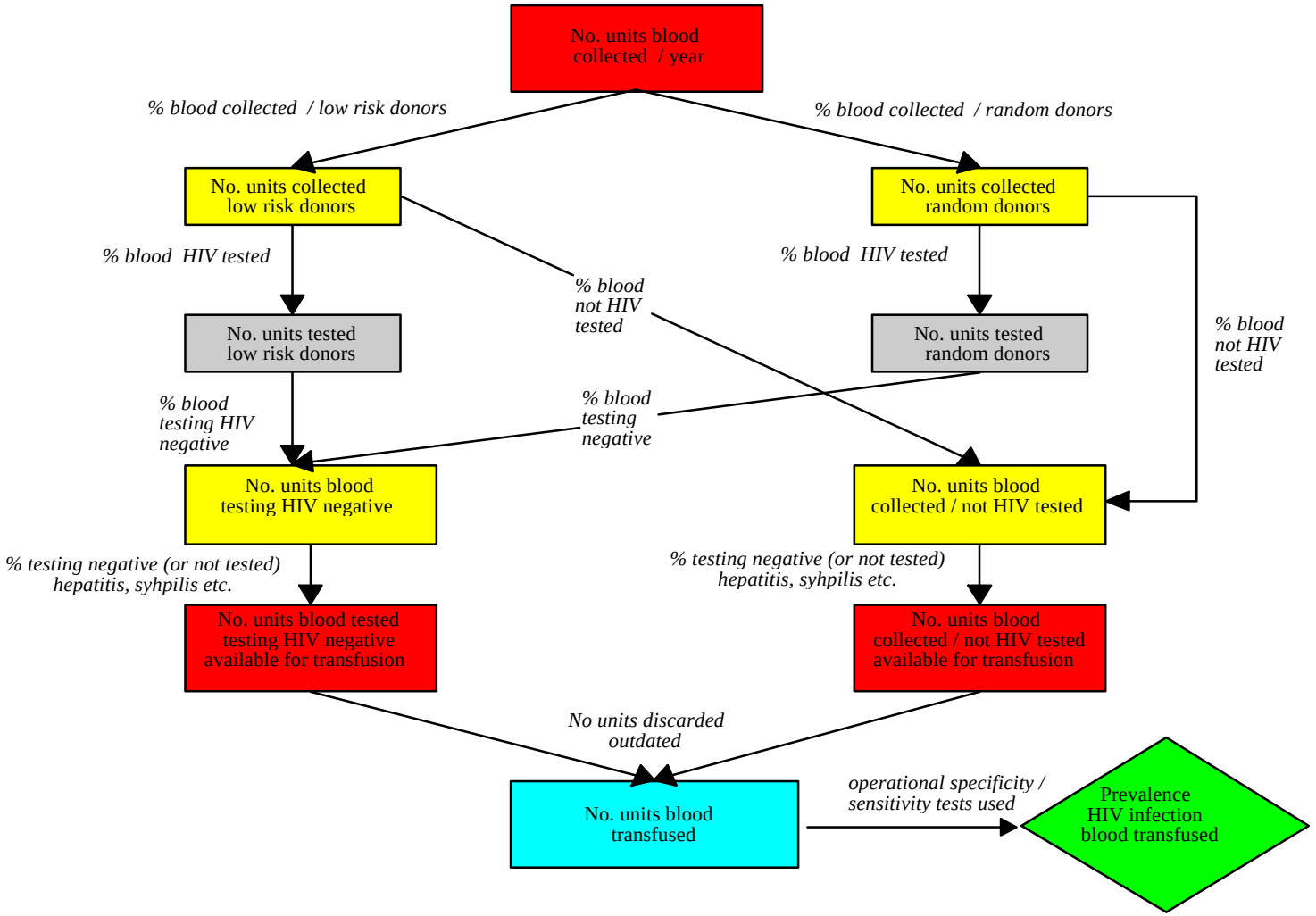
1.4 Model Outline

Figures *A*, and *B* (on the following pages) outline the conceptual framework and the main inputs of the model. These are described in more detail in *Section 2.2* of the manual.

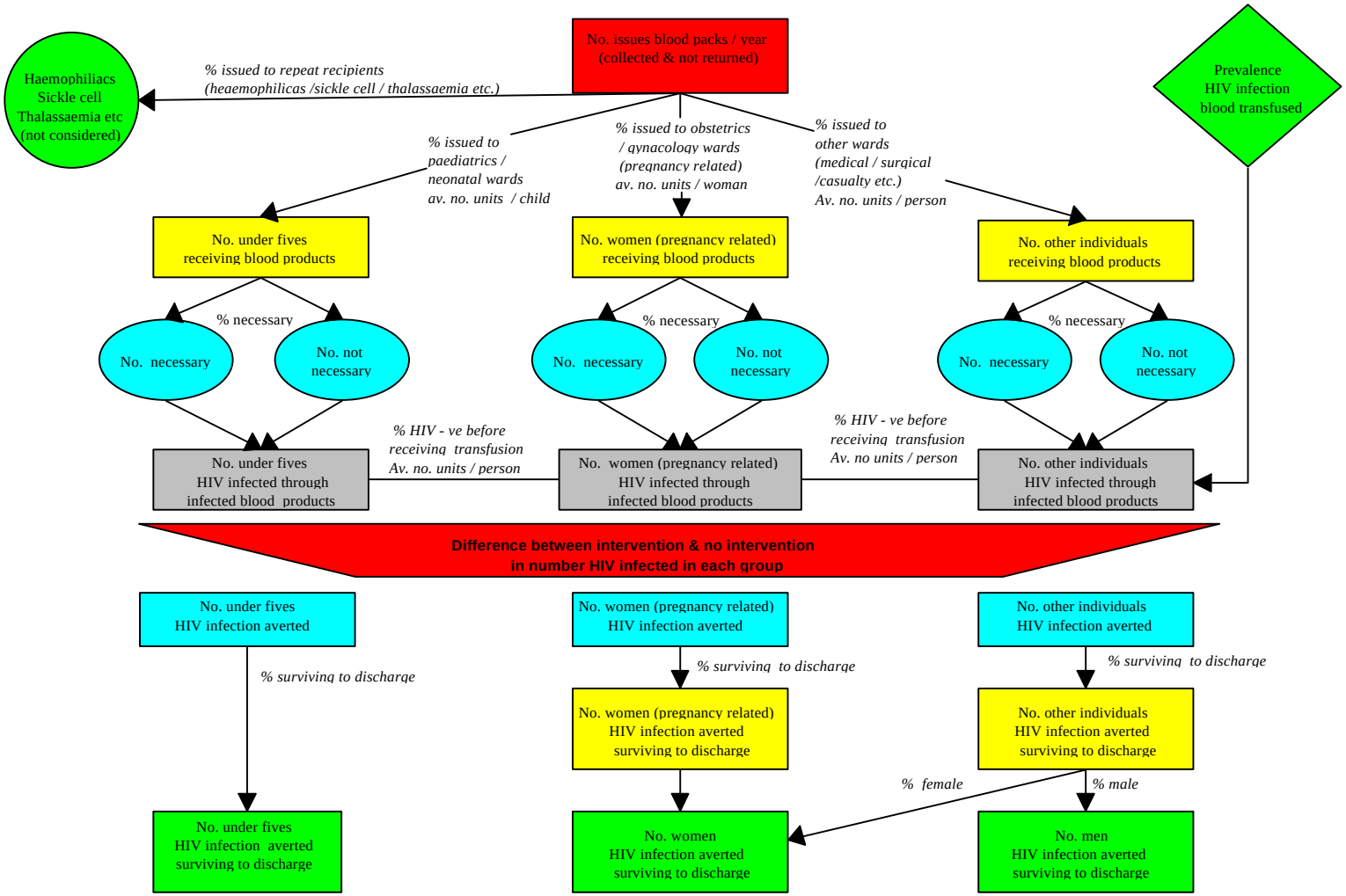
Figure A outlines the inputs used to describe how the patterns of HIV collection and testing that occur within a particular setting, how this has changed as a result of the intervention, and how this may influence the prevalence of HIV infection among blood transfused. In the figure, text written in italics represents inputs required by *Blood 3.0*. Text that is not in italics represents information that is calculated from these inputs. For example, the number of units of blood available for transfusion in any year will be dependent upon the total number of units collected; the proportion of blood collected from low risk compared with random donors; the percentage of each that is HIV tested; and the percentage of blood tested that tests HIV negative, and does not test positive for other diseases (such as syphilis or hepatitis).

Figure B outlines the inputs used to estimate the numbers of HIV infections averted among the main groups receiving blood products, and surviving to discharge. Again, text written in italics represents inputs required by *Blood 3.0*. Text that is not in italics represents information that is calculated from these inputs. Estimates of the prevalence of HIV infection in blood transfused, HIV prevalence among the main recipient groups, and estimates of the distribution of numbers of units provided to the different recipient groups are used to estimate the numbers receiving blood products, and the numbers of HIV infections that may occur. Comparisons between the estimates made in the presence and absence of the intervention are used to estimate the total number of HIV infections averted from the provision of safe blood products. This is combined with inputs describing the percentage of individuals within the main recipient groups surviving to discharge to obtain the final estimates of the total number of HIV infections averted by the intervention.

Sheet A: Blood collection & testing



Sheet B: Blood Transfusion



2. Installing and running *Blood 3.0*

2.1 Installing and opening *Blood 3.0*

Version 2.0 of *Blood 3.0* is a stand-alone progam designed for use on an IBM-compatible computer. The program can be run in either a DOS (using version 3.1 or higher) or windows environment. At present, the model is not in the public domain, and should not be distributed and copied. Once it has been further tested and finalised, it will become public domain software, which may be freely copied.

All of the files needed to run this program are on the floppy disk included with this manual. To install *Blood 3.0*, you need to run the file SETUP.EXE, included on the floppy disk.

Installing and opening from Windows 95, 97 or 98[1]

Step 1. Close all running applications and insert the *Blood 3.0* disk in your floppy disk drive

Step 2. In Windows Program Manager, choose Run from the [Start] menu

Step 3. Type 'a:\setup', where a: is the letter of your disk drive, and press [Enter]. This will start the installation process.

Step 4. A dialog box [HIV Prevention Models Version 2.0 Setup] will appear on your screen. Use the mouse to select the [OK] button on the dialog box or press [Enter] to continue the installation process.

Step 5. Another dialog box [COLLECTING SETUP INFORMATION ....] will then appear on your screen. This gives details of the location and name of the directory in which the *Blood 3.0* program files will be copied, the name of the program group in which the *Blood 3.0* program icon will be placed, and the location of the installation files. By default, the installation process will create a directory on your C: drive called 'Models', to contain the program files; and will create a program group 'HIV Prevention Models', in which to place the *Blood 3.0* program. The location and name of the directory, and/or the group name, and/or the location of the installation files can be changed by entering a different drive, directory name and/or group name in the dialog box. Once you have made any desired changes, use the mouse to select the [NEXT>>] button on the dialog box or press [Enter] to continue.

1. Windows 3.1, Windows 95, Windows 97 and Windows 98 are registered trademarks of Microsoft Corporation.

Step 6. A warning dialog box will now be shown on the screen, warning that the installation process cannot be completed if other applications are running. If necessary, use the [Alt]-[Tab] keys to switch to any open applications, and then close them. Once all other applications are closed, select the [OK] button or press [Enter] to continue with the installation process.

Step 7. A dialog box will now be shown providing information on the progress made in installing *Blood 3.0*. At any point, you can select the [ABORT SETUP] or press [Esc] to terminate the installation process. Once installation is complete, a dialogue box [CONGRATULATIONS!] will appear on the screen, to inform you that the model has been successfully installed. Select the [OK] button or press [Enter] to exit the installation program.

To run the program, click the *Blood 3.0* model icon within the 'HIV Prevention Models' program group.

Installing and opening from Windows 3.1[1]

Step 1. Close all running applications and insert the *Blood 3.0* disk in your floppy disk drive.

Step 2. In Windows Program Manager, choose Run from the [File] option.

Step 3. Type 'a:\setup', where a: is the letter of your disk drive, and press [Enter]. This will start the installation process.

Step 4. A dialog box [HIV Prevention Models Version 2.0 Setup] will appear on your screen. Use the mouse to select the [OK] button on the dialog box or press [Enter] to continue the installation process.

Step 5. Another dialog box [COLLECTING SETUP INFORMATION ....] will then appear on your screen. This gives details of the location and name of the directory in which the *Blood 3.0* program files will be copied, the name of the program group in which the *Blood 3.0* program icon will be placed, and the location of the installation files. By default, the installation process will create a directory on your C: drive called 'Models', to contain the program files; and will create a program group 'HIV Prevention Models', in which to place the *Blood 3.0* program. The location and name of the directory, and/or the group name, and/or the location of the installation files can be changed by entering a different drive, directory name and/or group name in the dialog box. Once you have made any desired changes, use the mouse to select the [NEXT>>] button on the dialog box or press [Enter] to continue.

Step 6. A warning dialog box will now be shown on the screen, warning that the installation process cannot be completed if other applications are running. If necessary, use the [Alt]-[Tab] keys to switch to any open applications, and then close them. Once all other applications are closed, select the [OK] button or press [Enter] to continue with the installation process.

Step 7. A dialog box will now be shown providing information on the progress made in installing *Blood 3.0*. At any point, you can select the [ABORT SETUP] or press [Esc] to terminate the installation process. Once installation is complete, a dialogue box [CONGRATULATIONS!] will appear on the screen, to inform you that the model has been successfully installed. Select the [OK] button or press [Enter] to exit the installation program.

To run the program, click the *Blood 3.0* model icon within the 'HIV Prevention Models' program group.

Installing and opening from DOS

Step 1. Close all running applications and insert the *Blood 3.0* disk in your disk drive.

Step 2. Type 'a:' and press [Enter], where a: is the letter of your disk drive.

Step 3. Type 'a:\setup', where a: is the letter of your disk drive, and press [Enter]. This will start the installation process.

Step 4. A dialog box [HIV Prevention Models Version 3.0 Setup] will appear on your screen. Press [Enter] to continue the installation process.

Step 5. Another dialog box [COLLECTING SETUP INFORMATION ....] will appear on your screen. This gives details of the location and name of the directory in which the *Blood 3.0* program files will be copied, and the location of the installation files. By default, the installation process will create a directory on your C: drive called 'Models', to contain the program files. The location and name of the directory, and/ the location of the installation files can be changed by entering a different drive, and/or directory name in the dialog box. Once you have made any desired changes, press [Enter] to continue the installation process. Press [Esc] to terminate the installation.

Step 6. A warning dialog box will now be shown on the screen. This warns that the installation process cannot be completed if other applications are running. If necessary, use the [Alt]-[Tab] keys to switch to any open applications, and then close them. Once all other applications are closed, press [Enter] to continue with the installation process.

Step 7. A dialog box will now be shown providing information on the progress made in installing *Blood 3.0*. At any point, you can select the [ABORT SETUP] or press [Esc] to terminate the installation process. Once installation is complete, a dialogue box [CONGRATULATIONS!] will appear on the screen, to inform you that the model has been successfully installed. Select the [OK] button or press [Enter] to exit the installation program.

To run the program:

1. Type 'cd\models' and press [Enter] to change to the Model directory
2. Type 'blood' and press [Enter] to run *Blood 3.0*.

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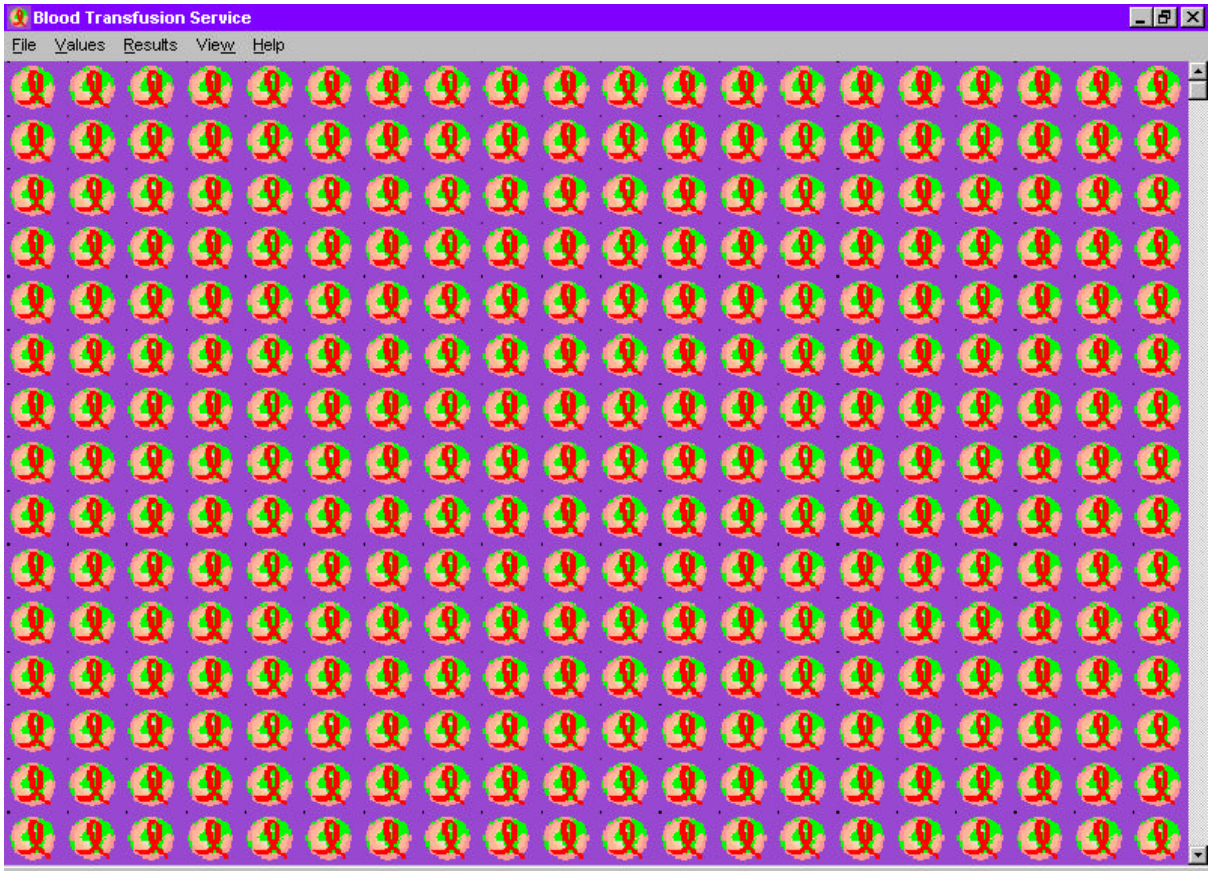
2.2 Running *Blood 3.0*

Once *Blood 3.0* has been opened, a screen containing the Main Menu will appear:



Selecting menu headings and menu items

Within a windows environment, the mouse can be used to select menu headings and menu items, to enter data, and to select a format in which to view the results. In addition, or when running *Blood 3.0* in a DOS environment, the following keys can be used:

Arrow keys The Up-Down and Left-Right arrow keys can be used to move up and down and between menu selections.

ENTER key The [Enter] key can be used to select menu options and to signal completed input of data into fields.

TAB key The [Tab] Key can be used to move in the forward direction between entry fields within any of the menu selection screens. Using both the [Shift] and [Tab] keys together allows movement in the reverse direction between entry fields.

ESC key The [Esc] key can be used to return to a higher menu level.

ALT key The [Alt] key, in combination with one of the letters underlined in the list of menu options, can be used to view the menu options. The [Alt] key, in combination with one of the letters underlined in the list of menu selections, followed by the [Enter] key, can be used to select an option.

3. Menu headings

Blood 3.0 has five primary menu headings: File, Values, Results, View and Help. These are described in turn below.

3.1 FILE

Within [FILE], it is possible to open new parameter files, edit existing files, access the default values, and exit the program. [FILE] can be selected using either the mouse, or by pressing the [Alt] and F keys together. Options within [FILE] can then be selected by using the mouse; using the down arrow key to move the highlighted bar down to the option required and pressing [Enter], or by pressing the [Alt] and the appropriately lettered key together.

File¦Open – can be used to locate and open saved files of input parameters. All input files for *Blood 3.0* have the extension NAME.bts. When *Blood 3.0* is opened, by default it will open the default parameter file. Existing files can be selected either by using the mouse, or by using the [Tab], arrow and [Enter] keys to move between folders and files.

File¦Save – can, in the same manner, be used to save the current input parameters in the open parameter file. It is not possible to alter the input values assigned to the default file.

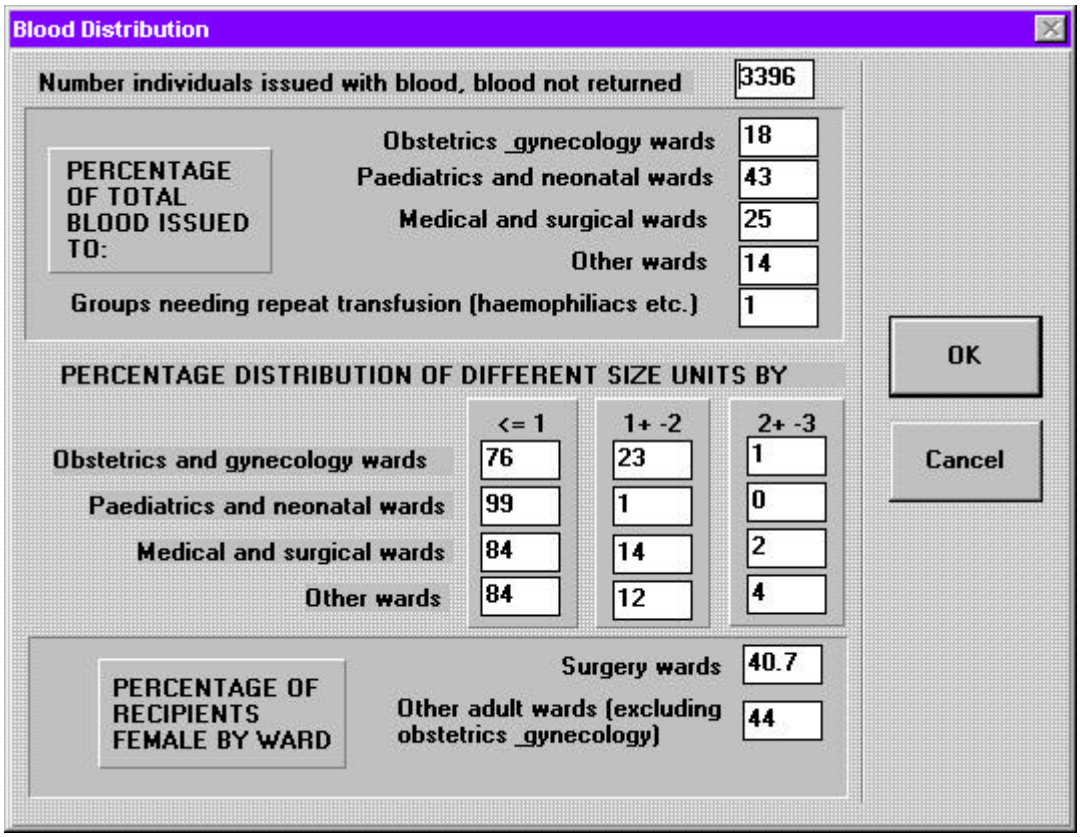
File¦Save as ... – can be used to save the current input parameters in a new parameter file, with the extension NAME.bts. This can be used to develop, for example, files of parameter values to represent blood transfusion services in a particular setting.

File¦Print - prints the current data output file.

File¦Exit - exits *Blood 3.0.*

3.2 VALUES

The [VALUES] menu is used to change the input parameters used in the program simulations. Five sets of inputs are required: collection; processing; wastage; distribution; extent necessary; and recipients. Within [VALUES], it is possible to modify the inputs used to reflect a particular intervention. [VALUES] can be selected either by using the mouse, or by pressing the [Alt] and V keys together. For illustration, the Blood Distribution input screen is shown below.



Options within [VALUES] can be selected using the mouse; or by using the down arrow key to move the highlighted bar down to the option required, and then pressing [Enter]. Once an option within [VALUES] has been selected, a list of inputs will be shown. The input values shown can be selected and altered either by using the mouse, or by using the [Tab] key or the [Tab] and [Shift] keys together to move between different entry fields. By clicking the OK button or pressing [Enter], the user can exit the option and return to the [VALUES] menu. If no further changes within this option are made, the input values shown at this point will be used in any subsequent calculations. More details about [VALUES] are given in *Section 4*.

3.3 RESULTS

The [RESULTS] menu has only one option - [CALCULATE]. [RESULTS] can be selected using either the mouse, or by pressing the [Alt] and 'R' keys together. [CALCULATE] can be selected either by using the mouse, or by first using the down arrow key to move the shaded bar to [CALCULATE], and then using the [Enter] key to select this option. The model will then use the current input parameter set to estimate the number of HIV infections averted by the intervention.

3.4 VIEW

Within [VIEW], it is possible to review all of the inputs from the model, either in total or for each separate screen, and to view a range of outputs relating to the impact of the intervention. The menu options are listed below:

◊ **Inputs** - shows the model inputs, either in total or for each separate input screen. Different options can be selected either by using the mouse, or by using the [SHIFT] and arrow keys together. These inputs are described in *Section 4*.

◊ **Outputs** - a range of outputs related to the impact of the intervention can be viewed. The user can choose to either view all of the outputs, or to view separately outputs related to blood collection, blood processing, estimates of the numbers transfused, estimates of HIV infections averted, estimates of HIV infections averted by different components of the intervention, and HIV infections averted and surviving to discharge. Within [OUTPUTS], it is also possible to view on screen the two flowcharts that describe the structure of the *Blood 3.0* model. The outputs are described in *Section 5*.

3.5 HELP

The 'About' option in the Help menu gives a summary of the Blood transfusion model. A more detailed Help function has not been developed.

4. Model inputs

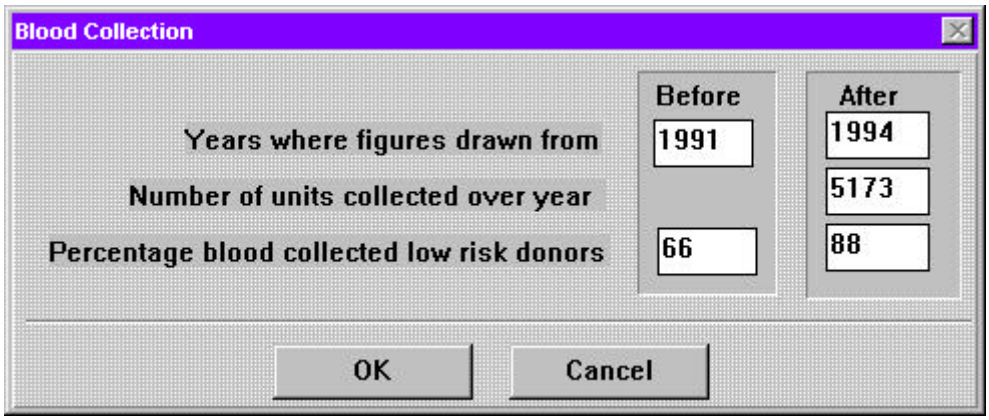
The model requires a range of input parameters, which are entered in the blood collection, blood processing, blood wastage, blood distribution, and extent necessary dialog boxes in the [VALUES] menu. The [VALUES] menu can be used to change the input parameters for the program simulations used in the calculations. The mouse, arrow and return keys can be used to move between different input screens, and to change the model's inputs.

Where appropriate, limits on the ranges of different parameters have been specified in the model (such as proportions being greater than zero and less than one). Where a number chosen falls outside the permissible range, an error sign is displayed, and the user is given the option to input a different number. The model comes with a default set of pre-assigned inputs. Each time the program is opened, the set of input parameters revert to their default settings. Other sets of inputs can be saved in [FILE], under the header [SAVE].

Each of the dialog boxes are described below. The default values are shown.

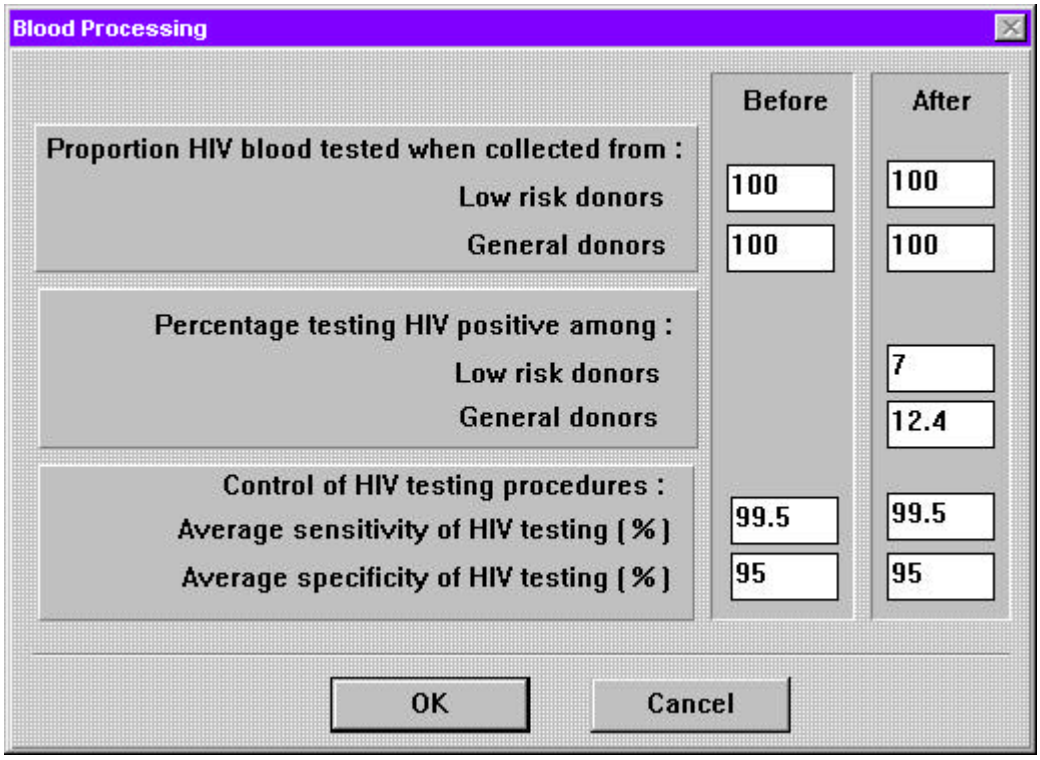
4.1 Blood collection

Inputs describing the years in which the 'before' and 'after' data were collected, the total number units collected in the 'after' year being considered, and the percentage of units that were collected from low risk donors (compared with general donors) before and after the intervention.



4.2 Blood processing

Inputs describing the percentage of blood collected from low risk and general donors that was HIV tested, before and after the intervention, and the percentage currently testing HIV positive among low risk and general donors, and the average sensitivity and specificity of the HIV tests used.

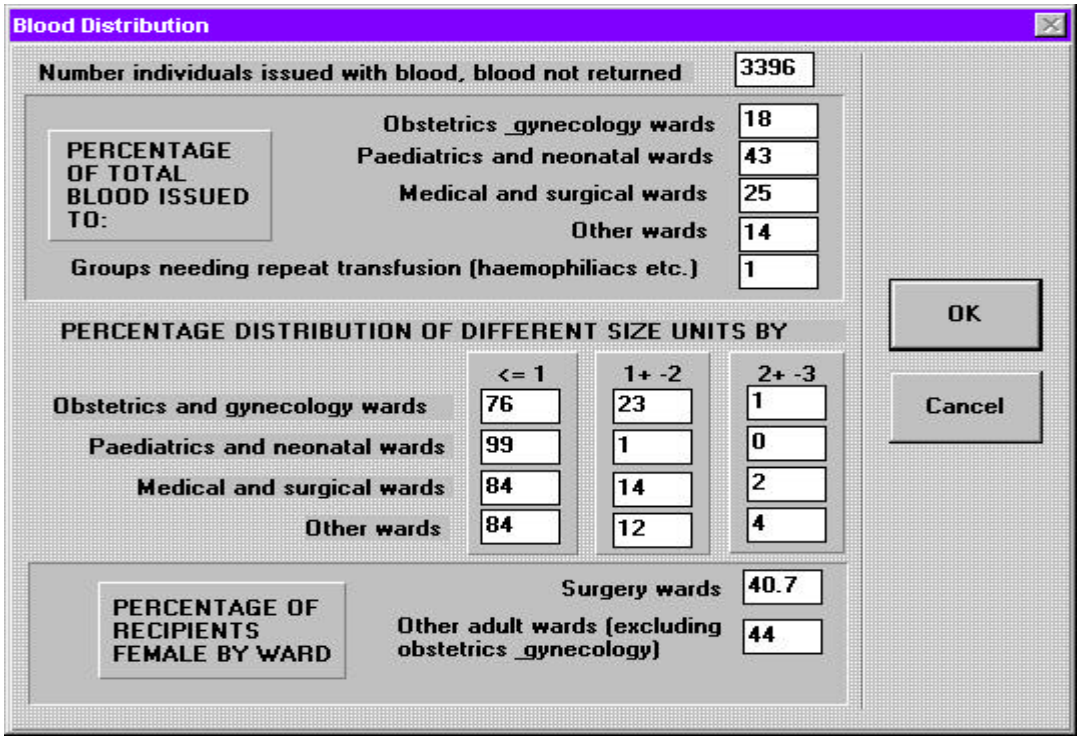


4.3 Blood wastage

Inputs describing the levels of blood wastage before and after the intervention, either because 1) it tests negative for HIV infection, but positive for other diseases; 2) was discarded after being in storage for distribution having been tested, or 3) was discarded after being in storage for distribution, not having been HIV tested.

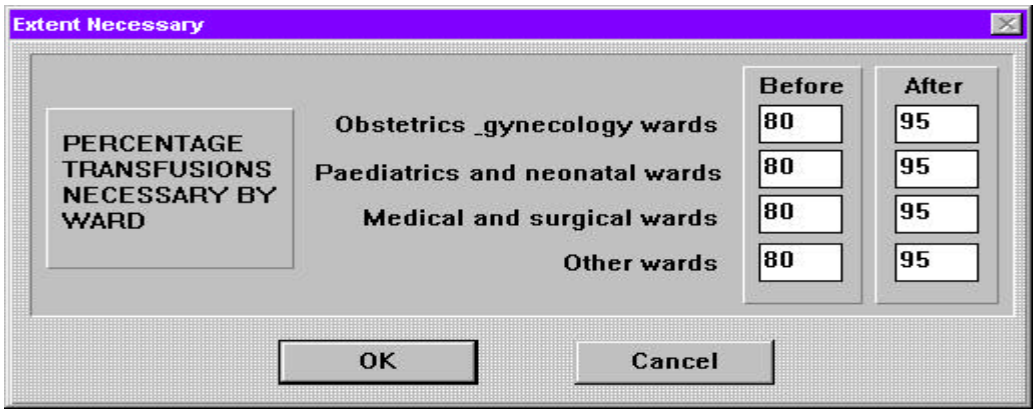
4.4 Blood distribution

Inputs describing: the patterns of distribution of units of blood between different wards (obstetrics and gynaecology, paediatrics and neonatal, medical and surgical, and other wards); the distribution in the average number of units of blood provided to each of these wards (less than or equal to 1 unit, 1-2 units, 2-3 units); and the percentage of blood transfusion recipients that are female on the medical and surgical wards, and other adult wards (excluding obstetrics and gynaecology).



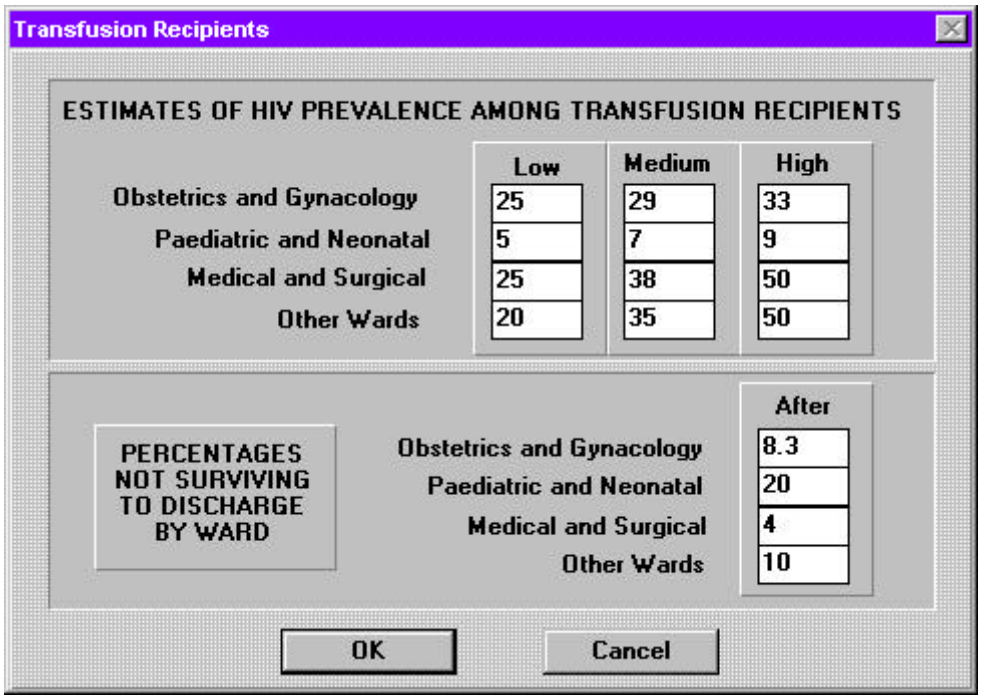
4.5 Extent necessary

Inputs describing the percentage of transfusions conducted that were necessary, before and after the intervention, according to the ward in which the transfusion was conducted. Clearly, as blood wastage is reduced, the total volume of blood required will decrease.



4.6 Transfusion recipients

Inputs describing estimates of HIV prevalence among transfusion recipients among the main wards receiving blood products and the percentage of transmission recipients not surviving to discharge. This input is used to estimate the numbers receiving blood products that are already HIV infected. Clearly, such people cannot be infected by infected blood products. As there is likely to be a degree of uncertainty associated with the HIV prevalence estimates, the model requires low, medium high estimates for each ward. These ranges are then used to obtain low, medium and high estimates of the numbers of HIV infections averted and surviving to discharge as a result of the provision of safe blood products.

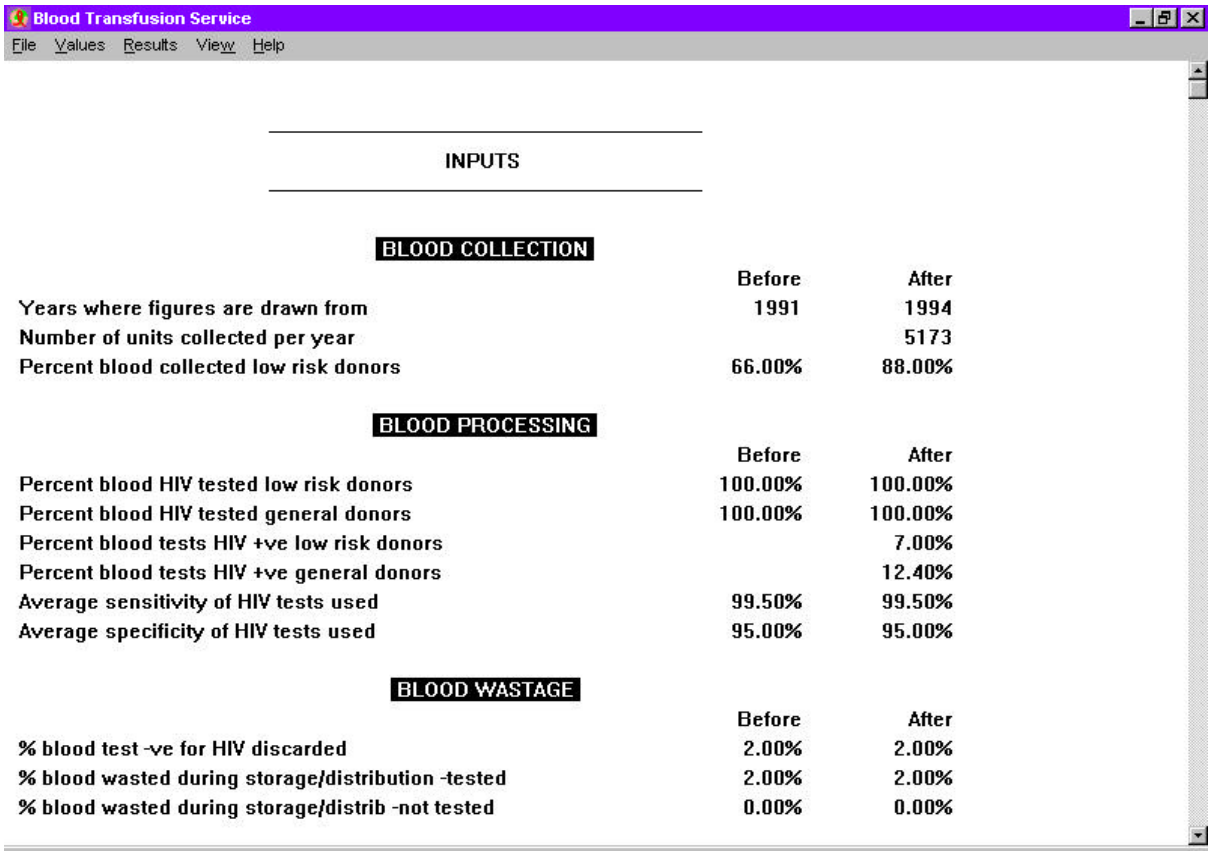


5. Model outputs

The output of the model is produced when the [CALCULATE] option is chosen from the [RESULTS] menu. The inputs and outputs of *Blood 3.0* can be viewed in a number of different formats as listed under the [VIEW] menu heading. These are described briefly below.

5.1 Data inputs

The [INPUTS] menu within [VIEW] can be used to view the main data inputs. The user can either view all the inputs or view separately inputs from different categories used in the input screens (blood collection, blood processing, blood wastage, blood distribution, extent transfusion required, recipients). These can be printed, or saved as a text file. An example the text shown is given below.



The scroll bar can be used to move down the screen.

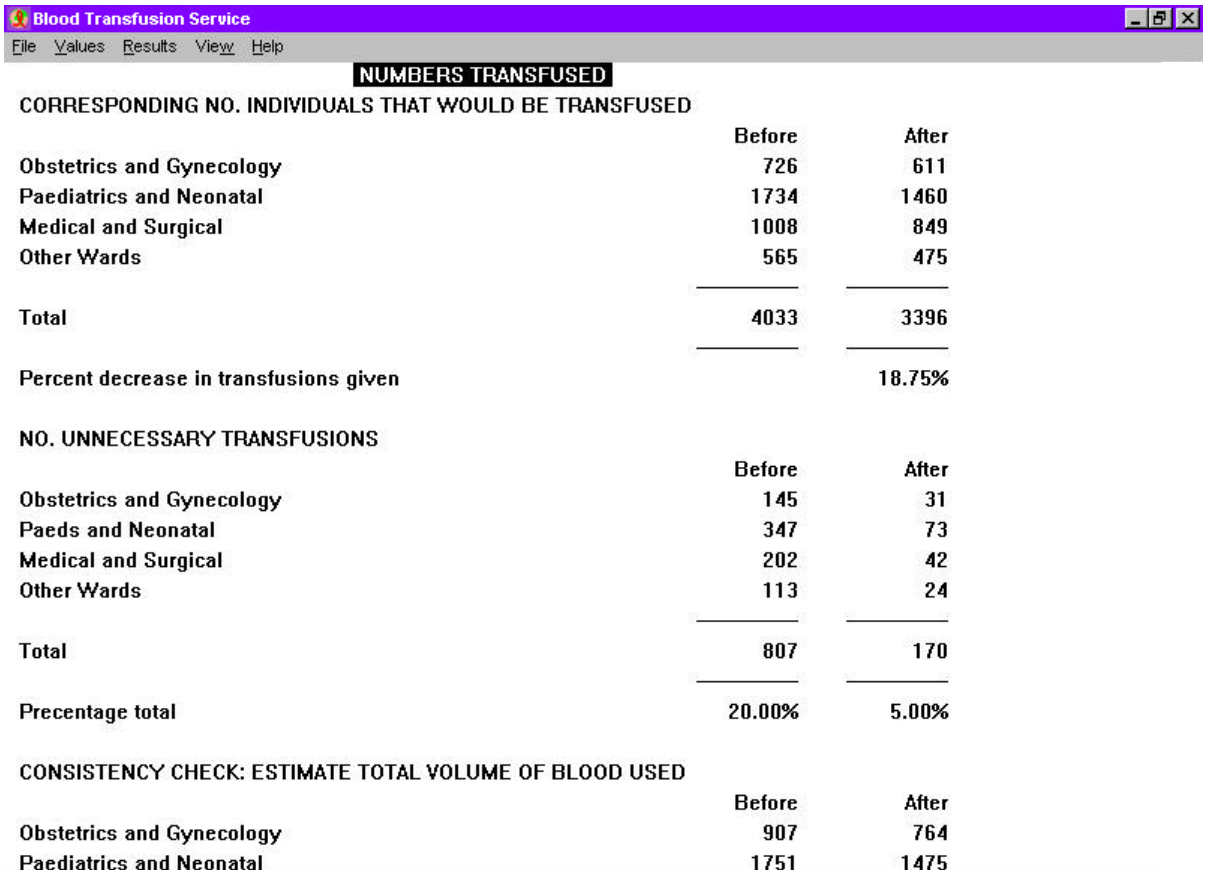
5.2 Outputs

The [OUTPUTS] menu can be used to view a range of data outputs from the model. Separate outputs relating to blood collection, blood processing, numbers transfused, HIV infections averted, HIV infections averted by component of the intervention, and HIV infections averted and surviving to discharge can be viewed. All of the outputs can be viewed, or specific forms of output can be viewed separately.

Below we show three of the output screens. The screens chosen illustrate how the different forms of output can be used to consider different dimensions of an intervention's impact and efficiency. The outputs shown below have been calculated using the default input parameters.

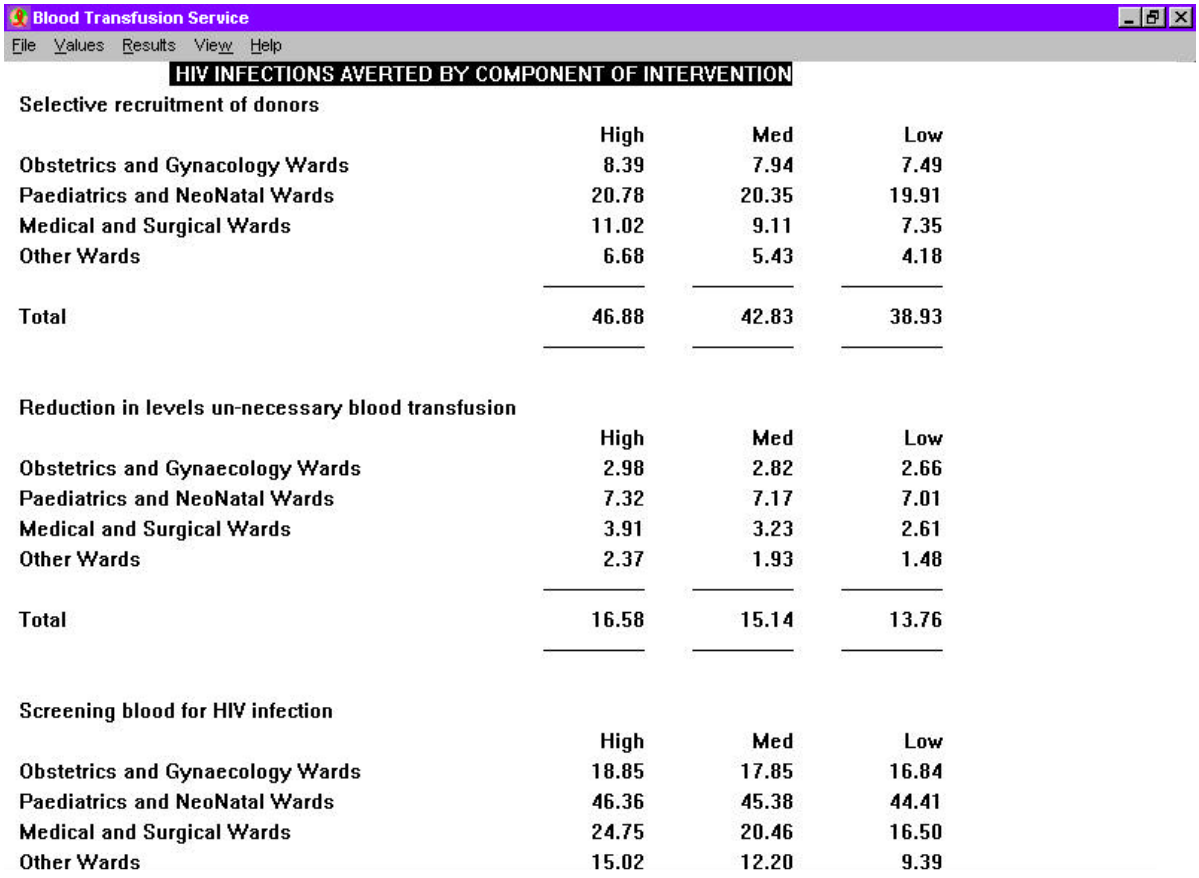
NUMBERS TRANSFUSED

Estimates of the numbers transfused by the main recipient groups, in the presence and absence of intervention, and an estimate of the extent to which the total number of transfusions given has changed as a result of the intervention. Shown also are estimates of the number of unnecessary transfusions occurring before and after the intervention, and the percentage of the total number of transfusions that this reflects. To allow consistency checks to be performed, estimates of the total volume of blood transfused by ward before and after the intervention are also given.



HIV INFECTIONS AVERTED BY COMPONENT OF INTERVENTION

Outputs showing the estimated number of HIV infections averted by three different components of the intervention (the selective recruitment of donors, reductions in the levels of unnecessary transfusion, and screening blood). The low, medium and high estimates correspond to the high, medium and low HIV prevalence estimates input for each ward. This breakdown allows the contribution of different components of an intervention to be assessed and also enables comparisons of the likely impact of different possible policy options to be explored.


Blood Transfusion Service

File Values Results View Help

HIV INFECTIONS AVERTED BY COMPONENT OF INTERVENTION

Selective recruitment of donors

	High	Med	Low
Obstetrics and Gynacology Wards	8.39	7.94	7.49
Paediatrics and NeoNatal Wards	20.78	20.35	19.91
Medical and Surgical Wards	11.02	9.11	7.35
Other Wards	6.68	5.43	4.18
Total	46.88	42.83	38.93

Reduction in levels un-necessary blood transfusion

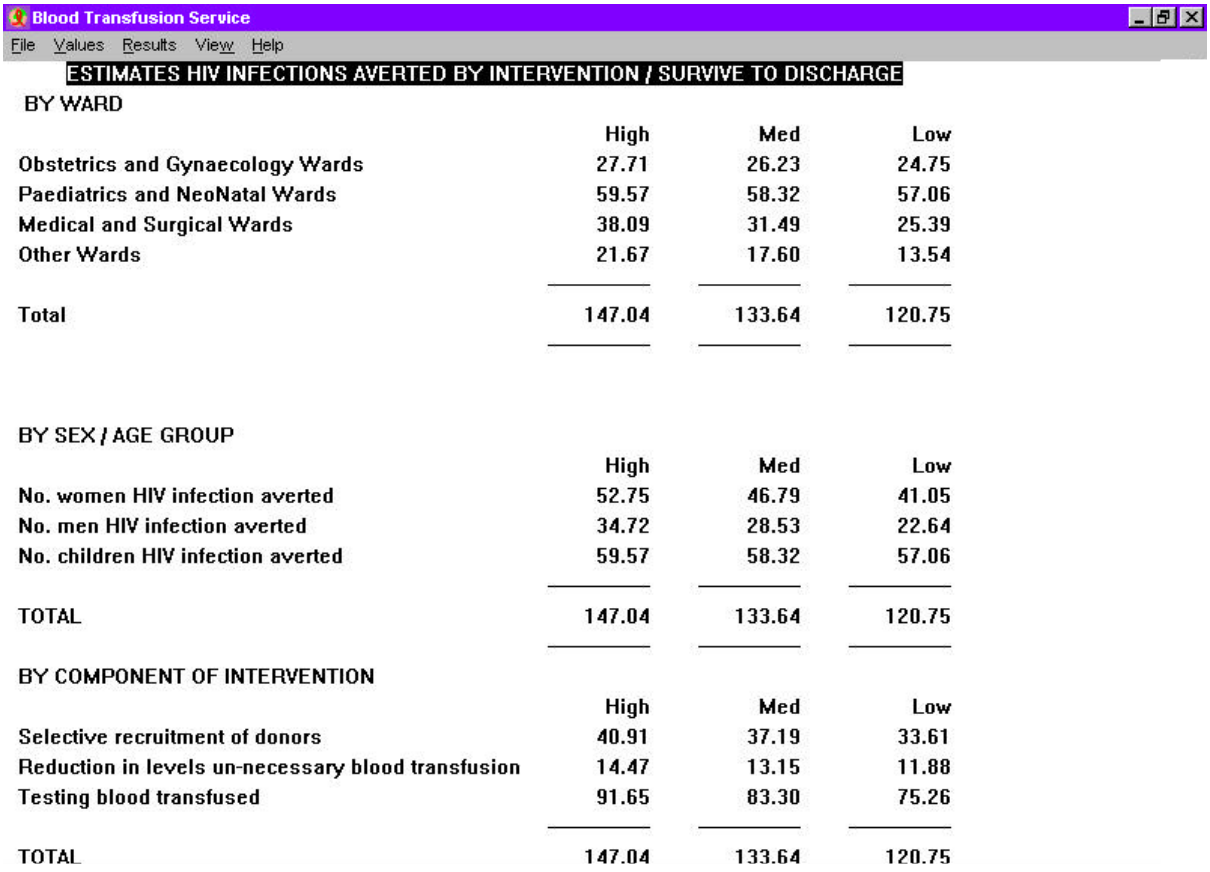
	High	Med	Low
Obstetrics and Gynaecology Wards	2.98	2.82	2.66
Paediatrics and NeoNatal Wards	7.32	7.17	7.01
Medical and Surgical Wards	3.91	3.23	2.61
Other Wards	2.37	1.93	1.48
Total	16.58	15.14	13.76

Screening blood for HIV infection

	High	Med	Low
Obstetrics and Gynaecology Wards	18.85	17.85	16.84
Paediatrics and NeoNatal Wards	46.36	45.38	44.41
Medical and Surgical Wards	24.75	20.46	16.50
Other Wards	15.02	12.20	9.39

ESTIMATES HIV INFECTIONS AVERTED BY INTERVENTION / SURVIVE TO DISCHARGE

Outputs showing estimates of the total number of HIV infections averted and surviving to discharge by ward, by sex/age group, and by the component of the intervention.



Blood Transfusion Service

File Values Results View Help

ESTIMATES HIV INFECTIONS AVERTED BY INTERVENTION / SURVIVE TO DISCHARGE

BY WARD

	High	Med	Low
Obstetrics and Gynaecology Wards	27.71	26.23	24.75
Paediatrics and NeoNatal Wards	59.57	58.32	57.06
Medical and Surgical Wards	38.09	31.49	25.39
Other Wards	21.67	17.60	13.54
Total	147.04	133.64	120.75

BY SEX / AGE GROUP

	High	Med	Low
No. women HIV infection averted	52.75	46.79	41.05
No. men HIV infection averted	34.72	28.53	22.64
No. children HIV infection averted	59.57	58.32	57.06
TOTAL	147.04	133.64	120.75

BY COMPONENT OF INTERVENTION

	High	Med	Low
Selective recruitment of donors	40.91	37.19	33.61
Reduction in levels un-necessary blood transfusion	14.47	13.15	11.88
Testing blood transfused	91.65	83.30	75.26
TOTAL	147.04	133.64	120.75

Appendix 1: *HIVTools* models and publications

1. Currently Available from UNAIDS

- *SexWork*: 3.0 Models the impact of interventions focused on sex workers and their clients.
- *Blood 3.0:* Models the impact of interventions to strengthen of blood transfusion services.
- *School 2.0:* Models the impact of interventions focusing on youth in school.
- *IDU 2.0:* Models the impact of strategies to reduce HIV transmission among injecting drug users.
- *Costing Guidelines for HIV/AIDS Prevention Strategies*
- *Costing Guidelines for HIV/AIDS Prevention Strategies Among Injecting Drug Using Populations.*

2. Publications

Kumaranayake L, Pepperall J, Goodman H, and Mills A. (1998) *Costing Guidelines for HIV/AIDS Prevention Strategies*. UNAIDS Best Practice Collection - Key Materials. http://www.unaids.org/highbrand/document/economics/index.html.

Kumaranayake, L. Mangtani P, Boupda-Kuate A, Foumena Abada JC, Cheta C, Njoumemi Z and Watts C. (1998) *Cost-Effectiveness of a HIV/AIDS Peer Education Programme Among Commercial Sex Workers: Results from Cameroon*. Presented at the XII World AIDS Conference, Geneva, 28 June - 3 July.

Mills A and Watts C. (1996). *Cost-effectiveness analysis of HIV prevention alternatives and the role of government*. Paper presented to the workshop >AIDS and development: the role of government=. Chateau de Limelette, Brussels, 17-19 June.

Watts C, Goodman H and Muyinda G. (1995) Estimation of the number of HIV infections averted by screening of blood. *The Lancet* 346: 783-4.

Watts C, Goodman H, Muyinda G, Msiska R, Mulenga D, Bertozzi S and Mills A. (1995) *Estimating the costs and impact of strengthening blood transfusion services in Zambia.* Abstract presented at the IXth International Conference on AIDS and STDs in Africa, Kampala, 10-14 December.

Watts CH. (1997) *Microbicides for HIV prevention: imperfect results and public policy*. Background paper for symposium on Practical and Ethical Dilemmas in the Clinical Testing of Microbicides. Women=s Health Advocates on Microbicides/The Population Council, Washington, USA.

Watts C and Kumaranayake L. (1999) Thinking big: scaling-up HIV-1 interventions in sub-Saharan Africa. *The Lancet* October 354: 1492.

Kumaranayake L and Watts C. Moderating discussions on the web: opportunities, challenges and lessons learned. Forthcoming *Health Policy and Planning.* March 2000.

Kumaranayake L, Watts C. *Costs of Scaling HIV Progam Activities to a National Level for Sub Saharan Africa: Methods and Estimates.* Forthcoming Washington, DC: World Bank.

Walker D, Vickerman P, Kumaranayake L et al. (1999). The importance of early intervention for HIV/AIDS prevention: The example of Belarus. Forthcoming *Mir Mediciny* (in Russian).

3. In progress

Watts C and Vickerman P. *SexWork*: new software to estimate the impact of interventions focused on sex workers on their clients.

Kumaranayake L, Watts C, Vickerman *et al*. Replication and costs of replicating interventions in Cameroon.

Watts C, Vickerman P, Vaughan P *et al*. What matters?: key factors influencing the impact of interventions focused on sex workers and their clients.

Vickerman P and Watts C. *IDU*: a user-friendly model to estimate the impact of HIV interventions among injecting drug users.

Kumaranayake L, Vickerman P, Walker D *et al*: The cost-effectiveness of HIV preventive measures among injecting drug users in Svetlogorsk, Belarus.

Kumaranayake L, Walker D, Dickun *et al*. Harm reduction activities among injecting drug users in Belarus: a cost analysis.

Vickerman and Watts HIV education for youth in school: a tool (SCHOOL) to model intervention impact.

Watts, Kumaranayake, Vickerman et al. The cost-effectiveness of HIV interventions in sub-Saharan Africa for youth in school.

Kumaranayake et al: the costs of in and out of school HIV interventions in Cameroon.

Watts, Goodman, Kumaranayake et al. Factors influencing the cost, impact and cost-effectiveness of initiatives to stengthen blood transfusion services.