The Modeling the Severity of Symptoms in Anaphylaxis

Adventures in Supercomputing Challenge
Final Report
April 5, 2006

Bosque School
Team #016

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Project Statement:

To model the over all severity of symptoms during anaphylactic shock by using the program C++ and using resources such as interviews with doctors, the world wide web, and books relating to our topic.

Executive Summary:

As always, we started off the year's work by choosing a very general topic for the Challenge: modeling what happens to the entire body during anaphylaxis. We soon realized that this was far too broad a topic for amateur programmers, so we began to scale down our project. Throughout the year, we have changed the focus of our project quite a few times; focusing on the heart, lungs and veins at respective times during the year. At last, after speaking with an allergist, we began to see that focusing on the severity of symptoms during anaphylactic shock would be a far more plausible project for us.

Background Information:

Anaphylactic shock is, on its most basic level, a severe allergic reaction, involving heightened levels of histamine and adrenaline. This term, which is sometimes called "anaphylaxis," literally means "without protection." It was first coined during the early nineteen hundreds by two men who were experimenting with dogs, attempting to build up their immunity to the venom of jellyfish by giving them small amounts of the poison over a long period of time. The scientists were hoping to be able to apply this idea to humans, however, their experiment had the precise opposite results of what they had been hoping for. The dogs, when given the venom, began to have severe reactions to previously non-lethal levels of the poison. Thus, the

term anaphylaxis was born. Over the years, it has been discovered that there are tens of thousands of people through out the United States who have severe, life threatening reactions to varying allergens. Some of the most common allergens are peanuts, shellfish, latex, and bees.

Our Method:

Our method this year has involved much trial and error; beginning primarily with a vast amount of research. We spent a few weeks researching anaphylactic shock, its history, severe allergens and such. By Glorietta, we had a general problem that we thought we could begin to model using C++. However, our research up to that point was incoherent and attempting to create a program that could accurately model a complex reaction such as anaphylaxis proved very difficult. We changed our problem a number of times, each attempt showing greater focus on a smaller topic. Eventually we talked with Doctor Amber West, an allergist in Albuquerque, who was willing to help by giving us coherent and accurate information. From our conversation with her and her colleague, we began to see the focus of our project. One team member began to attempt to transfer the information we learned from Dr. West into a program capable of accurately depicting the severity of the symptoms.

Our Results:

We currently have a program that is capable of modeling the severity of the symptoms during anaphylactic shock. In addition, we have a flow chart (in progress) and graphs; both of which mirror what our model does. To a degree, we were able to accurately model what occurs during this severe reaction. However in real life, a person experiencing anaphylaxis runs the risk of dying: should they not receive the proper amount of adrenaline. Although in our model, the person either lives or dies; depending upon whether the amount of histamine is above ten or vice

versa. This obviously is not consistent with our real life problem; however, our program is gradually becoming more accurate. We have a chart which graphs what our model does along with another graph that shows what occurs during anaphylactic shock. (See Appendix I) Below in Appendix I are three graphs, each display three outputs from our model. Most graphs are mostly self explanatory however Graph B is different and puts forth the problem of inconsistency with real life. One of the variables (adrenaline) falls below the x axis and into the negative numbers, we allow this for the flexibility of our program, while the variable does fall into the negatives, at the end it picks up and is at five by the time the program is through. This is an excellent example showing that the first epipen may not completely stop anaphylaxis so the victim may require two. Apart from Graph B our graphs are rather normal to that or regular anaphylaxis.

Our Conclusions:

The aim of our program was to be able to accurately model the severity of symptoms during anaphylactic shock. We were able to achieve this, as pre-stated above. Thusly, it is hard to find conclusions for our project; however the implications for what our program could be used for are obvious. If we were to have more time to work on our model, we could possibly alter the program so it could show at which point an adrenaline injection would be most beneficial. Our graph shows what our model represents and we have also included a graph that shows what occurs to a person who is being affected by anaphylaxis. If we had more time, one change we would make to our code is to make it capable of introducing a random adrenaline injection; making it so people would be able to see at which point during anaphylaxis a shot is most beneficial.

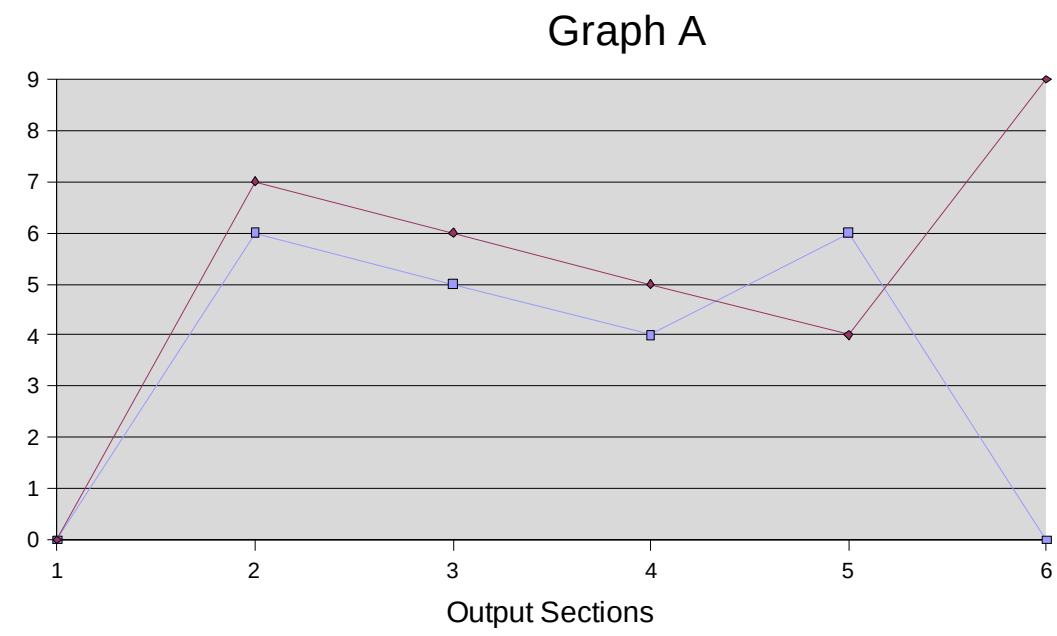
Our Big Achievement:

We would say that the greatest achievement we have had this year is our code. It took us a great deal of work to be able to get our code to the point where it accurately reflected our real life problem. For a while we were continually changing our problem and attempting to get our graph and flow chart to match the changing code. However after a lot of hard work, all of the characteristics of our problem and all of the different parts involved in completing this project at last came together. Therefore, creating a coherent model, graph and flowchart: all of which accurately model anaphylaxis. Overall, we have been successful at modeling our project and for our group this is a titanic achievement.

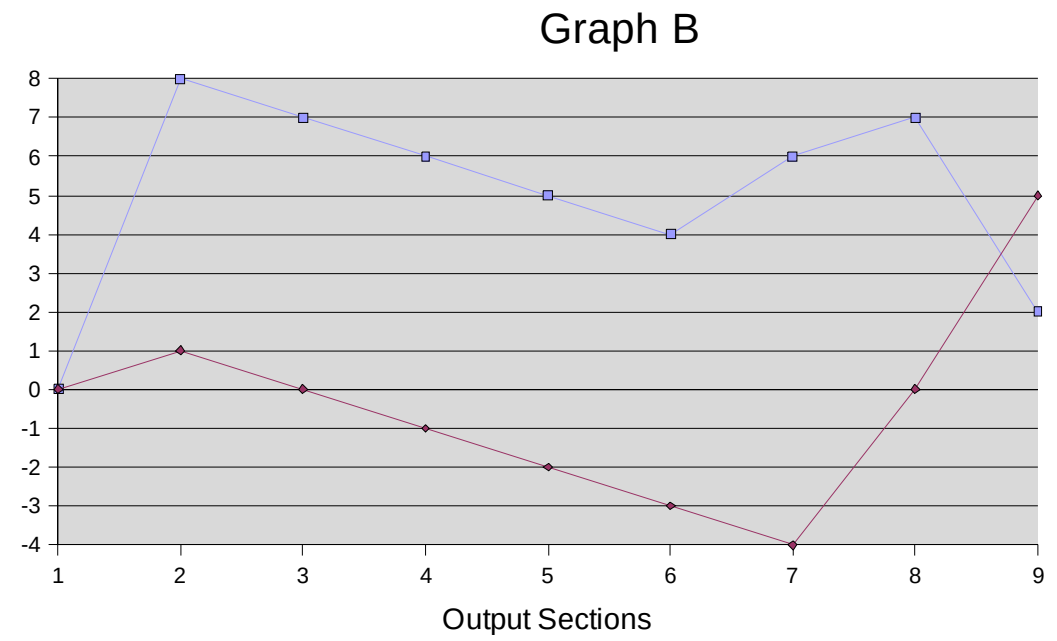
Acknowledgments:

We have many people to acknowledge for our accomplishments this year. The two most prominent people are Dave Shirely, an independent programmer who was always willing to help us and Dr. Amber West, an allergist who helped to point us in the right direction. Both Mr. Shirely and Dr. West aided us a lot and always tried to answer our questions to the best of their abilities. Dr. West met us one day after school, across town from where she worked and gave a great amount of information about anaphylaxis. Also, Jacqui Spence, the mother of a Bosque School student; who has a severe allergy to peanuts, was an inspiration for this project. We also cannot forget to mention our fellow Super Computers and Mr. Allen, who both helped us through out the year to achieve our goals.

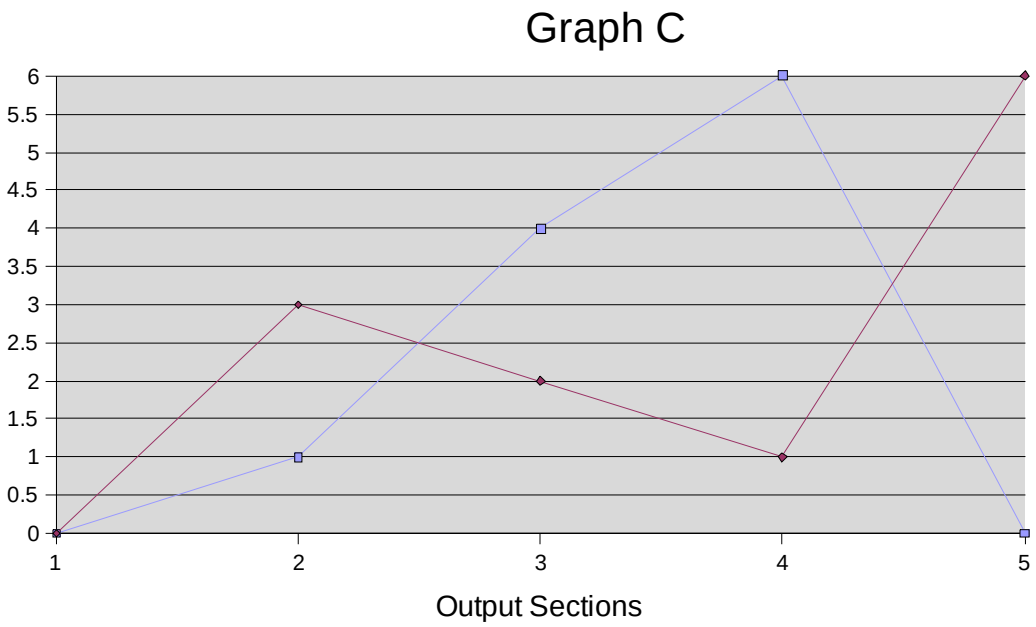
Appendix I: Graphs



Histamine	Adrenaline
0	0
6	7
5	6
4	5
6	4
0	9



Histamine	Adrenaline
0	0
8	1
7	0
6	-1
5	-2
4	-3
6	-4
7	0
2	5



Histamine	Adrenaline
0	0
1	3
4	2
6	1
0	6

Appendix II: Old Code

```
#include <iostream.h>
int main()
{
int A;
int G;      //Age
int H;      //Histamine
int B;      //Heartbeat
int K = 3;
int E;      //immunoglobin  E  !!!!!!
int M;      //maximum heart beat
int L;
int V;      //average heart beat
int x;
cout << "Enter age: ";
cin >> G;
cout << "Enter amount of histamine ( <10): ";
cin >> H;
cout << " ppm" << endl;
if (H > 10) cout << "impossible, try again";
if (H > 10) cin >> x;
else;
cout << endl;
if (G <= 12) cout << (B = 100);
```

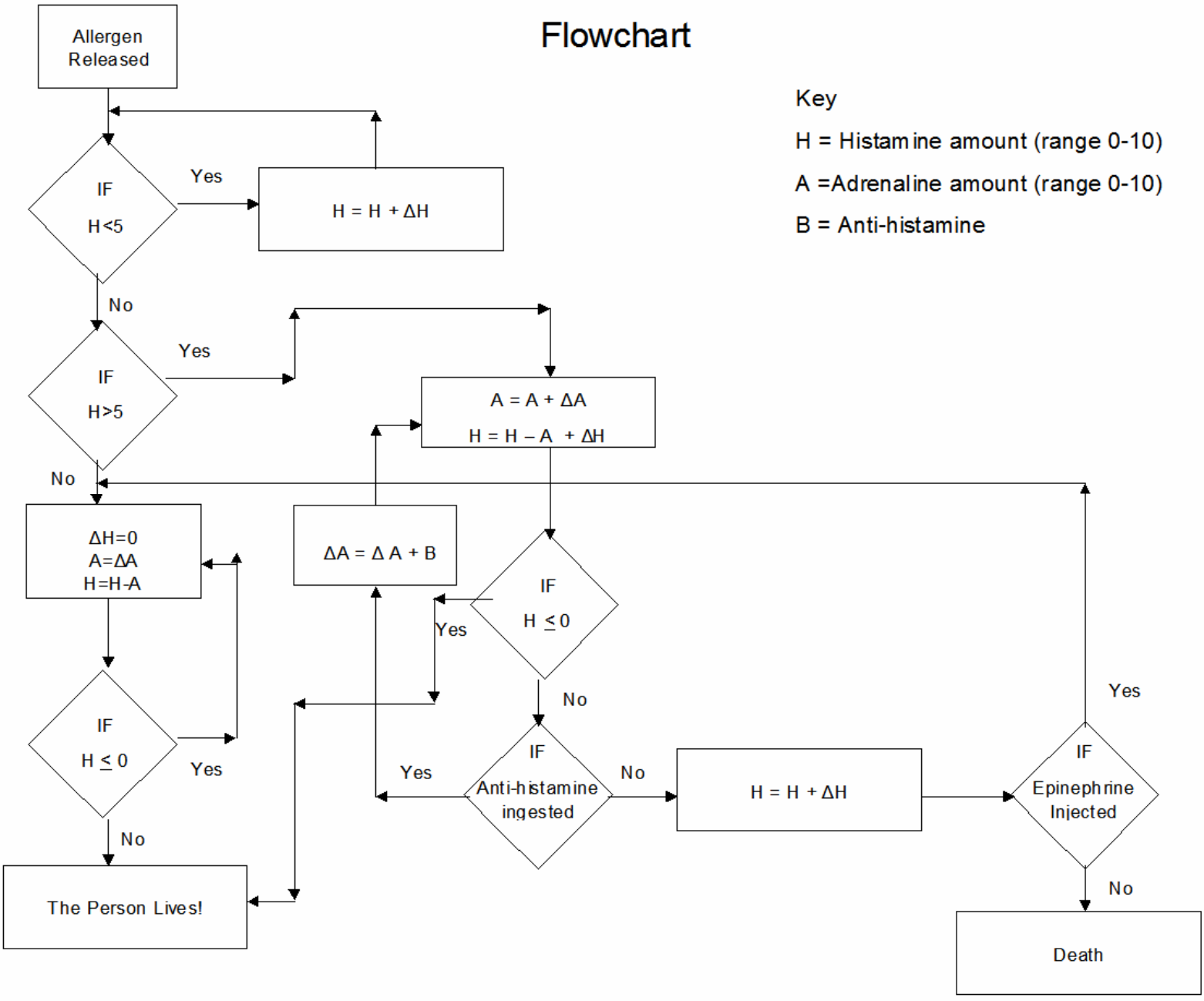
```
cout << (B = 150 - G);  //heart beat per minute will determine how fast the histimines will spread
cout << "Enter amount of adrenaline( <10): ";
cin >> A;                    //fatal part of shock can occur anywhere between 15 mins and 3 hrs.
cout << " cc";
cout << endl;
if (A > 10) cout << "impossible, try again";
if (A > 10) cin >> x;
else;



if (A > H);

   cout << "Oh No! Anaphylactic shock!!!" << endl;
   while (B <= 220)

{
   while (H > 0)
   {
      H = H--;
      B = B++;
      cout << "Amount of Histamines in the Blood Streams = " << H  << endl;
      cout << "Heart Beat = "<< B << endl;
      if (B > 220) cout << "victim dead";
      if (B > 220) cin >> x;
```

```
    }
    if (H = 0) cout << "victim survived, yay!";
    if (H = 0) cin >> x;
}
cin >> x;
  return 0;
}
```

Appendix III: Old Flowchart

Note: this is our original flowchart that attempted to follow our old code (Appendix II).

Our new flowchart is in Appendix V, and corresponds to our current sode. (See Appendix IV)



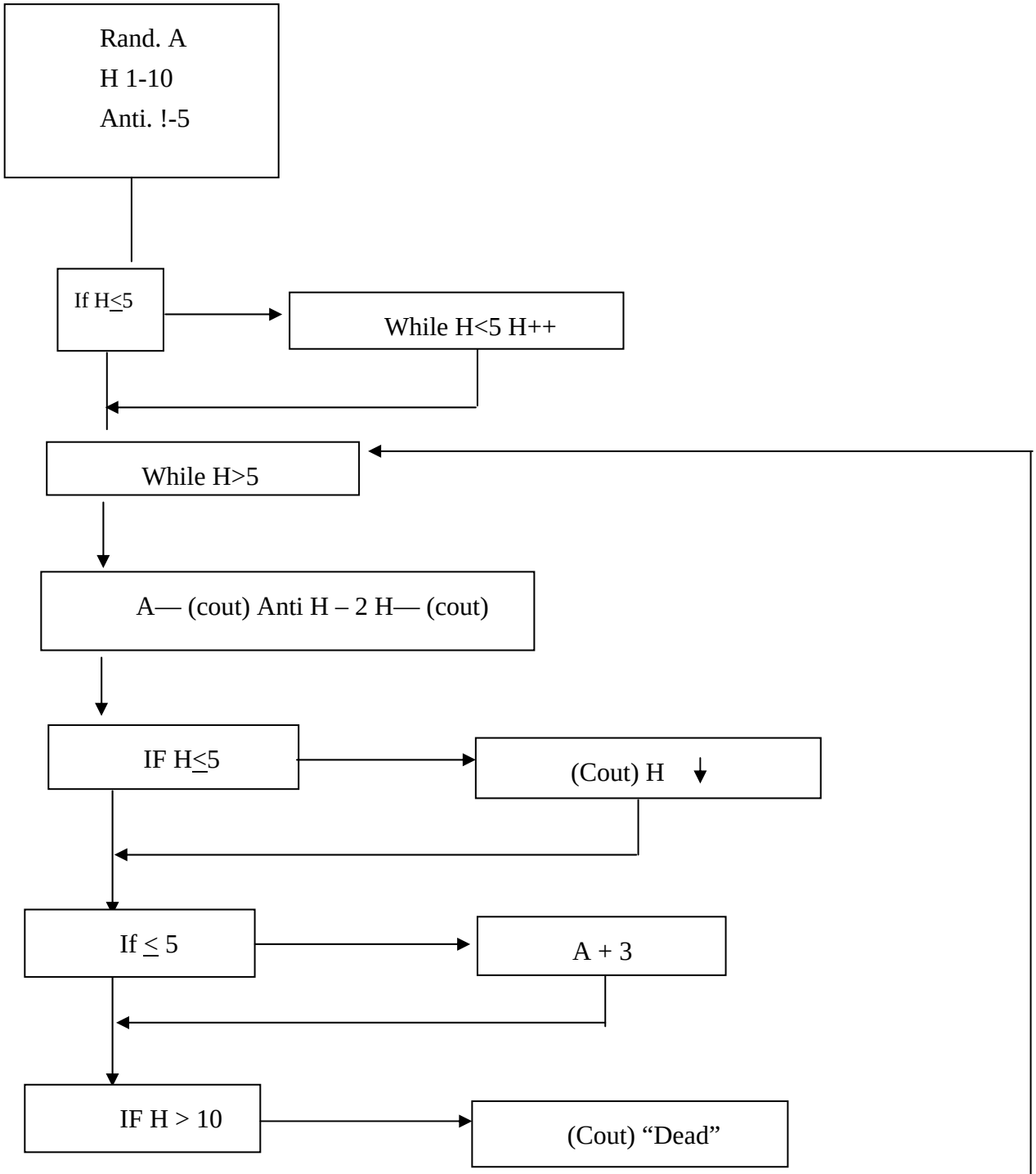
Appendix IV: Our Current Code

```
#include <iostream.h>
#include <cstdlib>
#include <ctime>
using namespace std;
int main ()
{
srand((unsigned)time(0));  // Random number generator
int random_integerH;
int random_integerA;
{
random_integerH = (rand()%10)+1;
random_integerA = (rand()%10)+1;
random_integerAnti_H = (rand()%5)+1;
}
int H = random_integerH;              // Histamine
int A = random_integerA;              // Adrenaline
int Anti_H = random_integerAnti_H ;    // Anti-Histamines
int x;
cout << "Histamine: " << H << endl;
cout << "Adrenaline: " << A << endl;
cout << "Anti-Histamine: " << Anti_H << endl << endl;
if (H < 5)
while (H < 5)
{
H++;
}
while (H >= 5)
{
  {
```

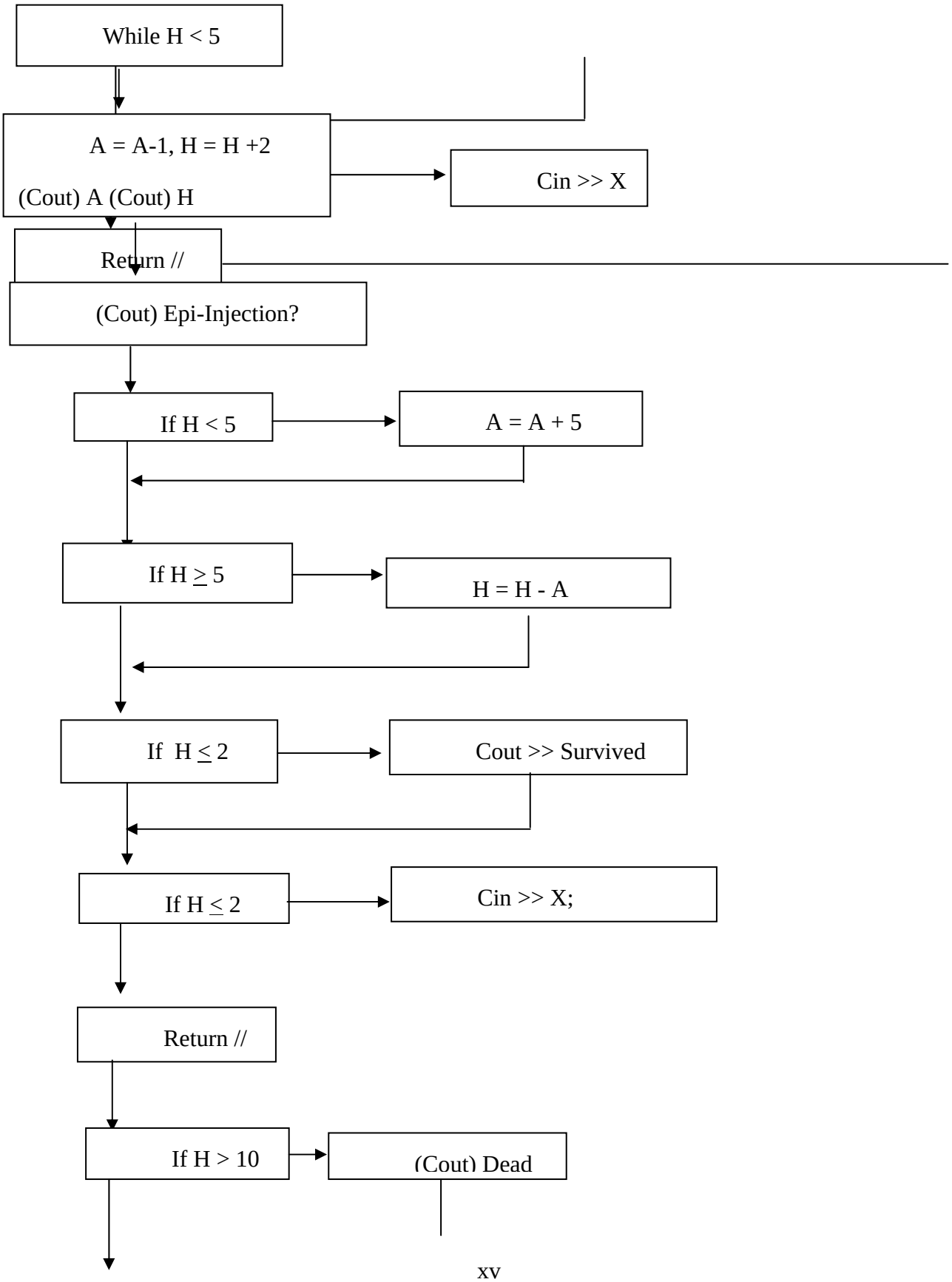
```
  A = A --;
  Anti_H = Anti_H - 2;
  H = H--;
    cout << "Amount of Adrenaline = "<< A << "cc" << endl;
    cout << "Amount of Histamine = " << H << "ppm" << endl;
    if (H <= 5) cout << "Natural adrenaline kicking in, histamines decreasing" << endl;
    if (H <= 5) A + 3;
   }
 if (H > 10) cout << "Shock to severe, victim dead.";
 if (H > 10) cin >> x;
 if (H > 10) return 0;
 }
 cout << endl << "Shock symptoms reincreasing." << endl << endl;
 while (H <= 5)
  {
     {
     A--;
     H = H + 2;
     cout << "Amount of Adrenaline = "<< A << "cc" << endl;
     cout << "Amount of Histamine = "<< H << "ppm" << endl;
     cout << "Victim may still Survive, epipen injected (+4 to adrenaline)" << endl;
     if (H >= 5) A = A + 5;
     if (H >= 5) H = H - A;
     }
     if (H <= 2)cout << "Histamine levels = " << H << "ppm" << endl << "Adrenaline
levels = " << A << "cc" << endl << "Victim Survived, program ended.";
     if (H <= 2)cin >> x;
     if (H <= 2) return 0;
  }
    if (H > 10) cout << "Shock to severe, victim dead, program ended.";
    if (H > 10) cin >> x;
    if (H > 10) return 0;
 cin >> x;
```

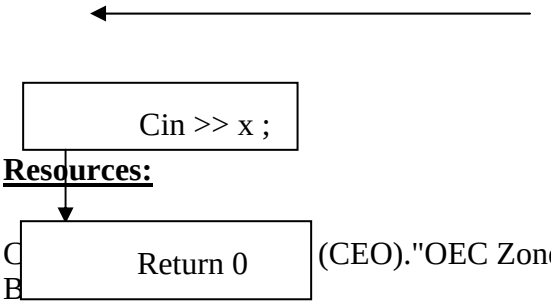
```
return 0;
}
```

Appendix V: New Flow Chart



Anaphylactic Shock





Resources:

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