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PUBLIC HEALTH SERVICE-HSM-CDC-Atlanta
EPI-68-87-2

July 31, 1970*

TO : Director, Center for Disease Control

FROM : Viral Diseases Branch
Epidemiology Program

SUBJECT: Viral Hepatitis - Cummins Prison Farm, Arkansas

SUMMARY

An increased incidence of hepatitis was noted at a Prison Farm in Cummins, Arkansas, between November 1967 and June 1968. This Prison Farm had experienced an outbreak of hepatitis in 1963-64 associated with a plasmapharesis program. Review of laboratory and clinical records revealed 168 prisoners with abnormal serum transaminase or bilirubin values in the "epidemic" period. Of 114 interviewed, 104 were active donors or had been rejected as donors because of laboratory abnormalities. Ten had never participated in the program. A survey of a 1/3 sample of the prison population revealed a recent history of hepatitis in 2.2 percent of active donors, 23.4 percent of inactive donors, and 1.5 percent of non-donors. SGOT and Australia antigen studies also revealed a higher incidence of abnormality in active or inactive donors than in non-donors. Although no means of transmission of the virus could be shown with certainty, it is clear that disease was in some way related to the plasmapharesis program.

Introduction

On Tuesday, May 28, 1968, Edward Shmunes, M.D., EIS Officer located at the Arkansas State Board of Health, telephoned Ronald F. Johnson, M.D., Chief, Viral Diseases Section, Epidemiology Program, NCDC, to discuss an outbreak of viral hepatitis at Cummins Prison Farm (Arkansas State Prison), about 60 miles southeast of Little Rock.

Between November 1967 and June 1968, approximately 150 cases of viral hepatitis were believed to have occurred among the 1500 inmates of Cummins Prison Farm. The cases occurred over the 7-month period, but there was an apparent clustering in February and March 1968. The mode of spread was not known. A plasmapharesis program was in operation at the prison in which plasma was regularly collected from selected donors and used for fractionation into commercial blood products. The role of plasmapharesis in the transmission of hepatitis at Cummins was not known.

*Information in this report is as of 1968.

At the invitation of J. T. Herron, M.D., State Health Officer, Arkansas State Board of Health, Kenneth R. Ratzan, M.D., EIS Officer, Hepatitis Unit, NCDC, and William Johnson, M.D., EIS Officer located at the South Carolina State Board of Health, joined the investigation. On Monday, June 3, 1968, Drs. Ratzan and Johnson met with Dr. Herron in Little Rock, Arkansas, and immediately traveled to Cummins Prison to meet with Mr. Victor Urban, Prison Superintendent.

Background

The Arkansas Department of Correction maintained two penal institutions, Cummins and Tucker State Farms. Cummins State Farm, a 16,500 acre tract, is 31 miles south of Pine Bluff, Arkansas in the fertile delta of the Arkansas River. It has been located at its present site since 1902 and houses approximately 1,500 inmates. The Tucker Unit is a smaller institution of 4,500 acres located 21 miles north of Pine Bluff; it accommodates approximately 275 inmates. Both prisons are primarily agricultural institutions which utilize the labor of the inmates to plant and harvest crops. The nutritional needs of the prisons are supplied solely by their farming industry, and the profits derived from the sale of the produce are used to maintain the institutions.

At the time of the investigation, Cummins State Farm had a total male population of 1,184: 694 black and 490 whites. In addition, the women's reformatory located at Cummins housed 41 females: 22 black and 19 white. The average yearly turnover of inmates at Cummins approaches 1,300.

Cummins is a medium security prison composed of concrete and steel buildings. All inmates live in 8 barracks, segregated by race. These dormitory units are referred to as "human cages" by both prisoners and personnel and are composed of row upon row of beds placed side by side, with just enough room on either side to form an aisle. In some barracks bunk beds accommodate the excess population. The barracks were built to house approximately 70-75 persons each, but each now contains 150-200 prisoners. One lavatory serves each of the barracks and contains a row of sinks, toilets, and open showers. All meals are eaten in a central mess hall which serves food cafeteria-style. All food is cooked in a central kitchen located adjacent to the cafeteria.

Prison life at Cummins is unique in that a great amount of intermingling among the inmates exists at all times. The men roam about freely within their barracks and within the mess hall. There is an elaborate trusty system composed of prisoners who have shown good behavior. Trusties are allowed to move at will through barracks and can walk freely around much of the prison grounds. Almost all persons serving as guards and carrying firearms are prison inmates who have reached trusty status.

The work schedule of the average inmate consists of labor in the fields--planting, and harvesting crops.

The water supply for the entire prison comes from two wells located on the grounds. The water is chlorinated prior to use. Sewage is handled by a common septic tank for the barracks and by individual tanks for the homes located on the prison property.

Approximately 85 employees (known as "free-world" personnel) staff the prison. Several live on the prison grounds in individual houses supplied by the prison. Many of the employees eat their lunches in the same mess hall and partake of the same food provided for the prisoners.

The medical facility at Cummins consists of an air-conditioned infirmary with a small but adequate emergency-treatment room, two wards of approximately 20 beds each, and an X-ray machine. Two physicians provide medical care for the inmates. They

commute by plane from England, Arkansas, about 70 miles away, and spend a total of three one-half days per week at the infirmary making rounds on the inpatients and seeing prisoners on an ambulatory basis. A technician (prison trusty) performs routine hematological and urine analyses and operates the X-ray machine.

Since 1962 Cummins has been actively engaged in a plasmapharesis program whereby its prisoners sell their plasma on a weekly basis. Cutter Laboratories is the primary purchaser of the plasma. In 1963-64, Cummins experienced a large hepatitis outbreak related to plasmapharesis. Improper technique allowed for cross contamination of plasma from prisoner to prisoner and resulted in several hundred hepatitis cases among the inmates who participated in the program. Since then, the faulty technique has been corrected and the plasmapharesis operation has been taken over by the Medcor Foundation, an organization directed by the University of Arkansas.

The plasmapharesis is carried out in a newly constructed, air-conditioned building, housing a chemistry laboratory and other necessary equipment. The plasmaphareses are performed Saturday, Sunday, and Monday of each week. Donors give 2 units (500 cc.) of plasma weekly in return for $5.00.

Before being accepted as a donor, an inmate receives a screening physical examination by a physician and is given a battery of blood tests which includes bilirubin, SGOT/SGPT, hematocrit, and total protein. Any one of the following can temporarily exclude a donor: SGOT or SGPT above 70, bilirubin above 1.0 mg. percent, hematocrit under 37, and total protein under 6.0 gms. percent. In the event of an abnormal test, a prisoner may be accepted as a donor when a repeat test is normal. All blood chemistries are performed in the plasmapharesis laboratory by a "free-world" employee. The laboratory also performs routine SGOT/SGPT and bilirubin determinations for the infirmary. However, these determinations are done at a separate time by a prison trusty.

In addition, each donor actively participating in the program is checked monthly for serum bilirubin and SGOT (SGPT is also done if bilirubin is abnormal). A bilirubin over 1.0 mg. percent and/or an SGOT over 70 will exclude a donor from the program until the SGOT is normal. In some cases this may be within 1 week. Those donors with SGOT/SGPT elevations over 500 and/or bilirubin values over 3.0 mg. percent are permanently excluded from the program. A donor with enzyme "elevations between 250 and 500 units may be reinstated (when his values return below 70) by the physician in attendance if there is good reason to doubt that the donor had hepatitis" (April 1968 regulations).

The plasmapharesis program at Cummins is an extremely productive and profitable one for the prison, the Medcor Foundation, and Cutter Laboratories. Approximately 60 percent of the total male inmate population actively participates in the program. In addition, 30-40 Tucker inmates are transported to Cummins each Monday to donate blood. During the 6-month period December 1967 through May 1968, 13,005 inmate donations provided 26,008 units of plasma. Cutter Laboratories supplies Medcor with most of the technical supplies and provides an IBM printout containing a summary and running tally of each donor's plasmapharesis record and the results of his routine chemistries. In addition, Cutter arranges for the weekly shipment of the plasma to Cutter Laboratories.

The prison had received a great deal of unfavorable publicity earlier in 1968 and the State's entire prison system was being severely criticized. The Prison Board of Directors was sincerely anxious to improve conditions at the prison and provide a more active role in the rehabilitation of the inmates.

The Outbreak

From the start of the investigation it was impossible to determine how extensive a hepatitis outbreak Cummins had experienced. Hepatitis had apparently been "endemic" at the prison for years, though no records were available to document this.

Since September 1967, two physicians had been in charge of medical affairs. The prison physician at the time of the investigation had taken charge in April 1968. Soon after starting his job he noted an "impressive" number of new cases of hepatitis among the inmates. As a result he soon made it a routine procedure for every new patient seen at the infirmary (both inpatient and outpatient) to have SGOT and bilirubin determinations. This apparently led to the detection of even more cases of "hepatitis".

Methods of Investigation

In order to estimate the number of cases of hepatitis experienced at Cummins in the previous 12 months the following steps were taken:

1. Hospital charts of patients admitted to the infirmary since January 1, 1968, were carefully examined. Not all charts were available for study.
2. A review of available laboratory data (SGOT, SGPT, and bilirubin) was made, including data from:
   a. All inmates screened before entering the plasmapharesis program since November 15, 1967.
   b. All plasma donors who had had routine monthly SGOT's since November 15, 1967.
   c. All patients admitted to hospitals who had SGOT, SGPT, and/or bilirubin determinations since November 15, 1967.
   d. All new patients visiting the infirmary since April 1968.
3. A "case" was defined as an individual with an SGOT or SGPT over 70 and/or bilirubin over 1.0 mg. percent. All patients still imprisoned at the time of the investigation were interviewed specifically with respect to history of jaundice, dark urine, anorexia, malaise, date of onset of illness, contact with a jaundiced inmate, abuse of parenteral drugs, and participation in the plasma program.
4. Questionnaires were mailed to all free-world employees inquiring about duration of employment, location of residence (on or off prison grounds), number of family members, regularity of eating meals in prison mess hall, and occurrence of hepatitis.
5. A survey of the prison was made among a random sample of 1/3 of each of three groups of inmates: current donors, inactive donors, non-donors. Each person was interviewed for prior history of [illegible] serum was [illegible]

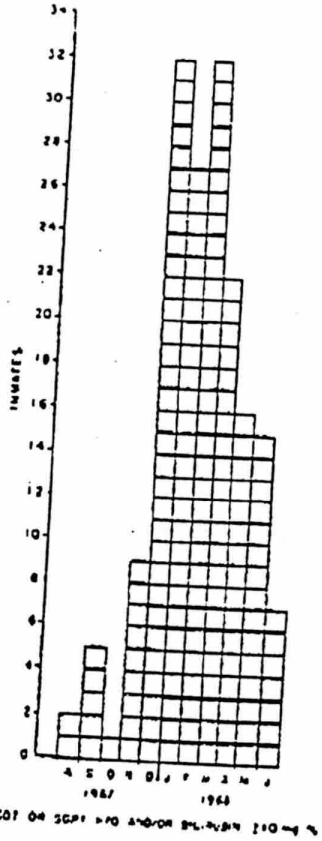
employees of Medcor and the enzyme tests were performed at the Coronary Drug Laboratory, NCDC, Atlanta. The Australia antigen studies were done by Dr. Paul Schmidt, Clinical Center, NIH.

6. Careful attention was paid to the plasmapharesis technique practiced at the plasma center. The procedures were scrutinized carefully for several hours to detect possible breaks in technique allowing for cross contamination of blood among donors.

Results of the Investigation

A case detection survey uncovered 168 persons who had a transaminase value (SGOT or SGPT) above 70 and/or a bilirubin of 1.0 mg. percent or above (Figure 1). Laboratory records were available only as far back as mid-November 1967. A few cases with onsets prior to this time were identified through the review of hospital records. Of the 168 persons, only 114 were still imprisoned at Cummins at the time of the investigation and were available for interview. Table 1 presents the age, history of jaundice, and donor status of the 114 persons interviewed. Only 10 persons with abnormal laboratory values had never been plasma donors; 104 were either active donors at the time of the interview or had been rejected from the program because of abnormal lab values.

Figure 1 INMATES STUDIED (168) BY MONTH OF ABNORMAL LABORATORY TESTS* AND ONSET OF JAUNDICE



*SGOT OR SGPT >70 AND/OR BILIRUBIN ≥1.0 mg %

Of the total group interviewed, 51 persons gave a history of jaundice and/or dark urine: 47 of 104 donors (45.2%) and 4 of 10 non-donors (40%). Figure 2A shows the month of detection of abnormal laboratory tests of the 63 individuals without history of jaundice; the month of onset of jaundice in the 51 others is shown in Figure 2B. Again it should be emphasized that these "cases" were identified from laboratory data that date back only to mid-November 1967. Data prior to this date were not available. Thus it was not possible to determine if the experience depicted in Figure 2 represented an actual increase in the number of persons with abnormal laboratory values or merely reflected the usual rate of abnormalities among plasma donors.

Figure 2A INMATES WITH NO HISTORY OF JAUNDICE BY MONTH OF ABNORMAL LIVER FUNCTION TESTS,* NOV. 1967 - JUNE 10, 1968

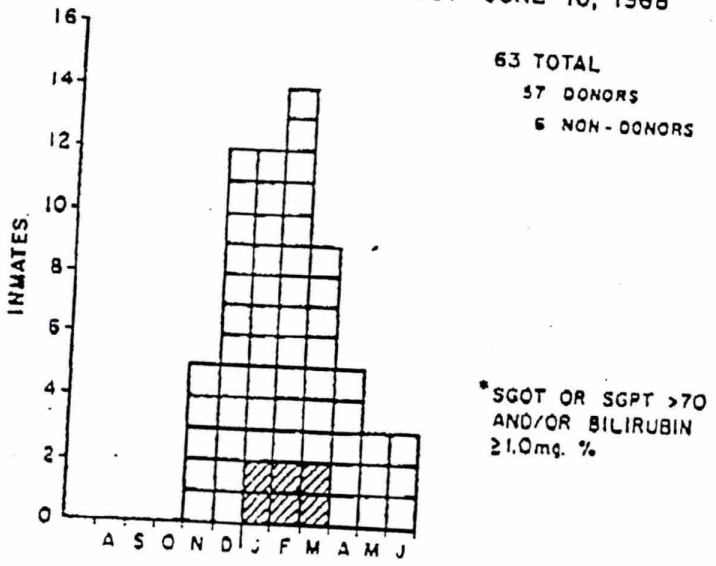
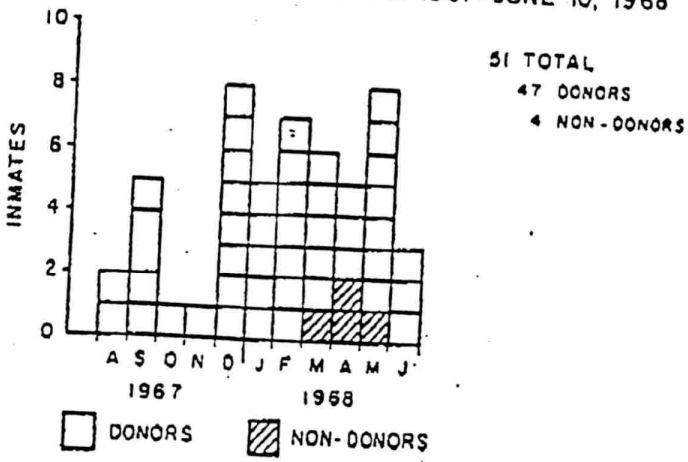
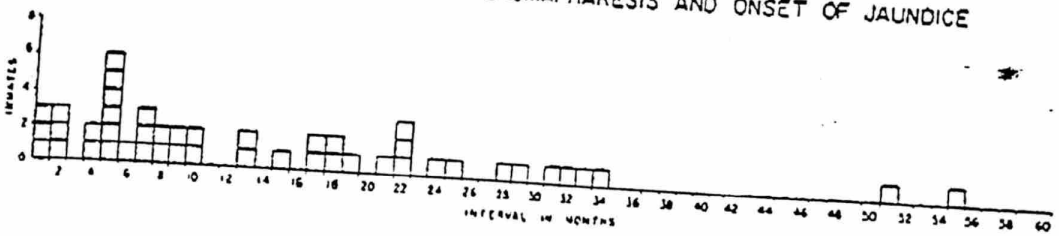


Figure 2B INMATES WITH JAUNDICE BY MONTH OF ONSET, AUG. 1967 - JUNE 10, 1968



For the 47 jaundiced patients who had been or were donors of plasma, the intervals between beginning plasmapharesis and onset of jaundice and/or dark urine could be determined in 46. These intervals are shown in Figure 3. Although there is a slight peak at 5 months, there is no true clustering of intervals to suggest a definite temporal relationship between entering the plasmapharesis program and onset of jaundice.

Figure 3 TIME BETWEEN BEGINNING PLASMAPHARESIS AND ONSET OF JAUNDICE



An analysis of the cases by race, housing facility (barracks number), history of drug usage, and history of contact with a jaundiced inmate was carefully made. Cases were equally distributed among all eight barracks and attack rates for white and black prisoners were not significantly different. None of the prisoners could recall specific contact with a jaundiced inmate or person prior to illness.

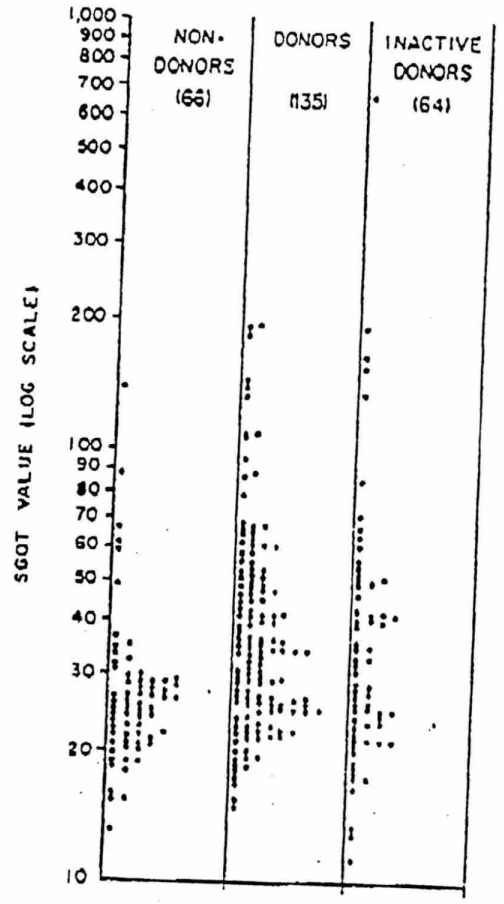
It became apparent during the course of the investigation that almost the entire population subjected to laboratory study came from the 60 percent of the prison population who were plasma donors. These people were required to have monthly laboratory determinations and were under routine "surveillance". Yet most of the cases came from this segment of the prison population.

It was quite possible that hepatitis was equally prevalent among the non-donor population but went undetected unless a prisoner obtained permission to attend sick call; it was often difficult for a prisoner to obtain this permission.

Accordingly, in order to detect hepatitis among the non-donor population a survey was conducted of the entire prison population. The prison roster was divided into three groups: inmates <u>never</u> donating plasma (non-donors); inmates <u>actively</u> (currently) donating plasma (donors); and inmates who had donated plasma in the past but who were <u>inactive</u>, either of their own volition and/or because of the development of an abnormal laboratory test or clinical illness diagnosed as hepatitis by the Medcor physician (inactive donors). The survey was designed to elicit a specimen for SGOT and Australia antigen determination. Table 2 presents the results of the survey. Of 141 persons who were currently donating plasma at the time of the survey, three gave a history of hepatitis prior to entering the program. Of the remaining 138 inmates who had no history of prior hepatitis, three developed hepatitis after beginning plasmapharesis (attack rate = 2.2%). Of 72 persons who had never donated

plasma, five gave a history of hepatitis prior to entering Cummins. Of the remaining 67, one developed hepatitis after entering the prison (attack rate - 1.5%). Of 71 persons who had previously donated plasma but who had either quit voluntarily or had been rejected because of an abnormal laboratory value or development of hepatitis, seven gave a history of hepatitis either prior to entering the program or during the 1963-64 plasmapharesis-associated outbreak. Of the remaining 64 inmates, 15 gave a history of hepatitis subsequent to plasmapharesis (attack rate 23.4%). The transaminase values for the total sampled population are presented in Figure 4. The figure shows SGOT values for 135 active donors (excluding 3 who gave a history of prior hepatitis and 3 whose bloods were lost due to breakage), 64 inactive donors (excluding 7 with prior hepatitis), and 66 non-donors (excluding five with prior hepatitis and one whose blood was lost). The geometric mean SGOT for the inactive and/or the active donor group was higher than the geometric mean SGOT for the non-donor group.

Figure 4 SGOT SURVEY AMONG INMATES AT CUMMINS, ARKANSAS, PRISON



Australia antigen (Au) studies were carried out on all blood specimens received. Eight active donors, of 138 tested, were Au positive (5.8%), as were 6 of 72 inactive donors (8.3%), and 2 of 71 non-donors (2.8%).

The questionnaire survey of the "free-world" personnel reached 81 employees and their families, totaling 312 persons. One hundred twenty-eight employees and dependents lived on the grounds of the prison and thus used the same water supply as the prisoners. Fifty-three employees ate some of their meals in the prison mess hall with the inmates. There had been no cases of hepatitis among any of the employees or their dependents during the previous 15 years.

An inspection of the plasmapharesis center, the equipment, the techniques, and the process of plasmapharesis itself revealed no obvious source of cross contamination of blood or plasma among the prisoners. All persons doing the venipunctures, blood letting, laboratory tests, and reinfusions of packed blood cells were well trained "free-world" personnel.

Discussion

It was difficult if not impossible to determine the extent of the hepatitis problem at Cummins and to relate it to previous experience. From November 1967 through May 1968 approximately 22 persons per month developed abnormal liver function tests compatible with viral hepatitis. As seen in Figure 1 the number of new persons developing lab abnormalities had decreased steadily since January. However, with no data available for periods prior to November 1967, one could not compare Cummins' recent experience with previous ones.

Living conditions at the prison were certainly favorable for easy spread of infection from person to person. Prisoners lived and slept virtually on top of one another. Personal hygiene was poor; the opportunity for fecal-oral transmission of hepatitis was great. Homosexuality was an aspect of prison life very much talked about but almost impossible to quantitate. This practice easily could account for person-to-person transmission of disease. Nonetheless, during the investigation it was impossible to relate any one person as the source of infection for any other prisoner.

It was rumored that parenteral drug abuse was widely practiced among the inmates. There was common agreement among the prisoners that "whatever you can afford, you can get." Certainly there was no shortage of needles; they could be obtained through the plasmapharesis program at the infirmary or the veterinary service for farm animals. It was acknowledged that despite precautions to prevent stealing of syringes and needles, there was still considerable loss.

Finally, there were very active and productive clandestine distilleries scattered throughout the prison grounds. During the course of his daily rounds the disciplinary officer would routinely uncover fruits of the labors of amateur and professional wine, beer, and whiskey makers. At best these products were crude, potentially toxic preparations containing variable concentrations of alcohol. Nonetheless, they apparently sold well.

There was no evidence for common source transmission of hepatitis at Cummins related to food or water. The "free-world" people, as well as the 40 women prisoners who shared the water, food, and milk supply with the male prison population, did not develop hepatitis.

Because the plasmapharesis program seemed to be a likely setting for transmission of hepatitis and because of the plasmapharesis-associated hepatitis outbreak at Cummins investigated in 1964 and traced to improper techniques in the plasma laboratory,

the plasma lab and its records were carefully studied. It has already been stated that the present plasmapharesis technique practiced at Cummins seemed satisfactory. Since the plasma lab did routine enzyme and bilirubin determinations among the donors, and these persons constituted almost the sole population group subjected to blood tests, it was obvious that most of these inmates with abnormal liver function tests would be from the donor group. For this reason a survey was performed to obtain a history and a serum sample for transaminase determination from a sample of the entire population, including prisoners not participating in the plasmapharesis program. As might be expected the prevalence of past hepatitis was higher among the population that had been rejected from the plasmapharesis program that among either the active donors or non-donors. However, the geometric mean SGOT of each of the donor groups (active and inactive) was significantly higher than that of the non-donor group (Figure 4). Australia antigen studies demonstrated a similar difference between non-donors and active or inactive donors. The presence of the antigen suggests that some of the hepatitis was serum rather than infectious hepatitis. This is the only information available which would indicate one form of hepatitis rather than another; the repetitive nature of exposure to needles precludes accurate assessment of incubation periods.

Several explanations for the differences between donors can be offered. Unfortunately, none can be substantiated with certainty. First, it is possible that the plasmapharesis technique did allow for significant but infrequent cross contamination of plasma or blood among the donors and was responsible for hepatitis, thus accounting for the higher geometric mean SGOT among the donor groups. Second, it is possible that the technique and process of repeated plasmapharesis led to SGOT abnormalities. Since whole blood must be centrifuged and the packed cells retransfused, there may be enough trauma to red cells in the process to increase their fragility, allow for intravascular hemolysis, and raise the SGOT. Against this theory is the fact that the geometric mean SGOT of the inactive donors (many of whom had not donated for months) was not different from the active donors. Third, and most difficult to quantitiate, is the fact that participation in the plasma program provided the donor with five dollars per week with which to purchase goods and services within the prison. Thus, a donor was in a position to purchase drugs for parenteral abuse, purchase the services of a homosexual partner, or purchase the plentiful home-made spirits. Any one of these purchases could lead either directly to liver damage or to an increased risk of acquiring viral hepatitis, each of which would account for elevated SGOT's.

Finally, it is possible that the donors and non-donors differed in ways other than participation in the plasmapharesis program. For instance, it is conceivable that persons willing to admit to weekly venipunctures and blood letting have a penchant for needles and indeed are prone to abuse parenteral drugs. Moreover, there may be a greater percentage of alcoholics among the donors than non-donors. These considerations could not be ruled in or out on the basis of the available data.

In summary, then, the occurrence of abnormal liver function tests among a population of prisoners at Cummins State Farm was documented. Because of sampling bias, the great majority of these abnormalities were in persons participating in a plasmapharesis program at the prison. A serological survey of the prison demonstrated that the geometric mean SGOT was higher among persons either currently selling plasma or persons who had voluntarily quit or had been rejected as donors than among persons who never donated plasma. Australia antigen studies reflected a similar pattern. The significance of this finding could not be fully determined, although plasmapharesis could not be ruled out as the means by which hepatitis was being transmitted.

Living conditions at the prison were favorable for spread of disease, especially fecal-oral transmission of infectious hepatitis. However, the extent and importance of this means of transmission of hepatitis could not be determined.

Table 1

INTERVIEWED PRISONERS WITH ABNORMAL LIVER FUNCTION BY AGE, HISTORY OF JAUNDICE, AND DONOR STATUS

	Donors			Non Donors			Total		
	Jaundice	No Jaundice	Total	Jaundice	No Jaundice	Total	Jaundice	No Jaundice	Total
0-14									
15-19	3	4	7	1		1	4	4	8
20-24	17	17	34	2		2	19	17	36
25-29	12	11	23		1	1	12	12	24
30-34	8	10	18	1		1	9	10	19
35-39	5	5	10		5	5	2	5	10
40+	2	10	12	4	6	10	15	17	
TOTAL	47	57	104	4			51	63	114

Table 2

RESULTS OF SURVEY OF PRISON POPULATION*

Donor Category	Hepatitis	No Hepatitis	Total*	Rate (%)
Active	3	135	138	2.2
Inactive	14	49	64	23.4
Non Donor	1	66	67	1.5
TOTAL	19	250	269	7.1

*Excludes 3 "Active", 7 "Inactive", and 5 "Non-donors" who had had hepatitis prior to entering the prison or the plasmapharesis program.

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