Food And Drug Administration's Investigation Of Defective Cardiac Pacemakers Recalled By The General Electric Company

Department of Health, Education, and Welfare

BY THE COMPTROLLER GENERAL OF THE UNITED STATES

MWD-75-71

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MARCH 10, 1975

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-164031(2)

The Honorable Abraham Ribicoff, Chairman
Committee on Government Operations
United States Senate

Dear Mr. Chairman:

In response to your July 2, 1973, request, this is our report on the Food and Drug Administration's investigation of defective cardiac pacemakers recalled by the General Electric Company.

The Administration is part of the Department of Health, Education, and Welfare. As requested by your office, we have not obtained the Department's written comments on matters in the report.

We do not plan to distribute this report further unless you agree or publicly announce its contents. In this connection, we invite your attention to the fact this report contains recommendations to the Secretary of Health, Education, and Welfare. As you know, section 236 of the Legislative Reorganization Act of 1970 requires the head of a Federal agency to submit a written statement on actions he has taken on recommendations to the House and Senate Committees on Government Operations not later than 60 days after the date of the report, and the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report. If we obtain your agreement to release the report, we will make it available to the Secretary and the four committees for the purpose of setting in motion the requirements of section 236.

Also, matters discussed in the report may be of interest to other congressional committees in their consideration of legislation for improving the Department's regulation of medical devices, such as cardiac pacemakers.

Sincerely yours,

Elmer B. Staats

Comptroller General
of the United States

Contents

ABBREVIATIONS

BMDDP	Bureau of Medical Devices and Diagnostic Products
FDA	Food and Drug Administration
GAO	General Accounting Office
GE	General Electric Company
HEW	Department of Health, Education, and Welfare

COMPTROLLER GENERAL'S
REPORT TO THE CHAIRMAN
COMMITTEE ON GOVERNMENT
OPERATIONS,
UNITED STATES SENATE

FOOD AND DRUG ADMINISTRATION'S INVESTIGATION OF DEFECTIVE CARDIAC PACEMAKERS RECALLED BY THE GENERAL ELECTRIC COMPANY

Department of Health, Education, and Welfare

D I G E S T

WHY THE REVIEW WAS MADE

GAO was asked to review the Food and Drug Administration's activities involving regulation of cardiac pacemakers. Specifically, it was requested for information concerning the Food and Drug Administration's efforts to

--investigate General Electric Company's recall of malfunctioning cardiac pacemakers and

--establish safety and performance standards for pacemakers.

FINDINGS AND CONCLUSIONS

The Food and Drug Administration, a constituent agency of the Department of Health, Education and Welfare (HEW) is responsible under the Federal Food, Drug, and Cosmetic Act (FD&C Act) for regulation of medical devices (including cardiac pacemakers) that are shipped in interstate commerce.

The Administration's Bureau of Medical Devices and Diagnostic Products in Rockville, Maryland, administers the Food and Drug Administration's program for regulating medical devices.

The Administration can initiate legal actions--prosecutions, injunctions, and seizures--through the Department of Justice, when it considers medical devices to be adulterated or misbranded, but does not have recall authority.

Recalls of products are made by the voluntary action of manufacturers. The Administration monitors manufacturers' recalls to determine whether recalled products pose any potential hazard to health and to insure that recall actions will be successful in protecting consumers.

In January and April 1972, General Electric Company recalled about 574 implantable standby cardiac pacemakers--model A2072--because abnormally high pacing rates caused by the presence of moisture, which, in combination with other factors, affected the pacemaker's performance.

Of the 574 pacemakers, 352 were implanted in people living in the U.S. and the rest were distributed to foreign countries or held in General Electric's inventory.

MWD-75-71

Overall findings

The Administration needs to strengthen its regulation of implantable cardiac pacemakers. Its recall procedures call for measures to insure the prompt removal of defective products from the market and the identification and correction of the cause of the defect. The Administration did not take such measures in connection with General Electric's recall of defective cardiac pacemakers.

Inspection of General Electric's manufacturing facility

Recall procedures require that the Administration conduct an in-depth inspection of the manufacturing facility in which the recalled product was produced. The Administration's authority with regard to medical devices is limited to visual inspection of the manufacturing facility.

The Administration initiated its investigation after learning of the recall on April 8, 1972, from various newspaper articles.

The Administration's visual inspection of General Electric's manufacturing facility was not complete in that it did not include an inspection of the area used for life-testing pacemakers.

According to an Administration official, an inspection of this area was important for determining the cause of the defect. Also, Administration district office officials indicated that the Administration had not issued good manufacturing criteria for pacemakers.

They also said Administration inspectors needed additional guidelines, training, and experience to effectively conduct inspections at manufacturing facilities in which complex medical devices such as cardiac pacemakers are produced. (See pp. 4 to 7.)

Collection and examination of pacemaker samples

The Administration's recall procedures require that any Administration district office involved in a recall promptly collect and examine samples of the recalled product. According to the Administration's Inspection Operations Manual the collection and examination of a recalled product can provide tangible evidence of adulteration or misbranding and could serve as the principal basis for determining the need for regulatory action.

An Administration official said that he did not believe the Administration needed to examine samples of the recalled pacemaker to determine that it was defective, as General Electric informed the Administration that several recalled pacemakers would fail.

Although a manufacturer reports a problem concerning its products, the Administration should examine samples of the recalled

product to determine the need for regulatory action. (See pp. 7 and 8.)

Public disclosure

At the time of the recall, the Administration's recall procedures required the Administration, in all life-threatening situations, to:

--place a notice of the recall on a recall list for distribution to the trade press and selected Government agencies and

--issue a public warning through the news media.

Although General Electric's pacemaker recall involved a life-threatening situation, the Administration did not comply with its procedures.

According to an Administration official failure to place a notice of the General Electric pacemaker recall on a recall list was due to an administrative oversight.

A public warning was not issued through the news media because General Electric had already issued a warning to each user's physician. GAO noted, however, that one pacemaker user was not located through General Electric's efforts.

In September 1973 the Administration revised its recall procedures to require public warnings only when there is a need to alert affected parties.

In lieu of a public warning, the Administration may issue a statement of facts to the appropriate segment of the public affected by a recalled product without alarming others not involved in the recall.

Because of the concern that such procedures could withhold from the public vital information concerning a defective and potentially hazardous product, legislation (H.R. 216, 94th Congress, and H.R. 10916, 93d Congress) has been introduced to prohibit the Administration's withholdholding such information from the public. (See pp. 8 and 9.)

Investigation of effectiveness of General Electric's recall

The Administration's recall procedures require that it investigate the effectiveness of a manufacturer's product recall.

In a case involving an imminent hazard to health, the recall procedures required the Administration to contact all of the product consignees (i.e., physicians and hospitals) to insure that the consignees had received notification of the recall and to develop information concerning injuries and complaints associated with the product.

The Administration did not contact all of General Electric's pacemaker consignees but found that at least five physician

consignees had not received notification of the recall from General Electric.

Therefore, the Administration did not develop complete information on injuries and deaths associated with the 352 pacemakers that were distributed in the U.S.

The Administration made investigations involving 68 of the recalled pacemakers. According to Administration records, seven deaths and two injuries were attributed to the defective pacemaker.

The Administration did not conduct investigations in connection with the remaining 284 recalled pacemakers that were distributed in the U.S. (See pp. 9 and 10.)

The Administration's evaluation of need for regulatory action

The Administration cited General Electric for violations of the adulteration and misbranding provisions of the FD&C Act involving four of the recalled pacemakers that were associated with users' deaths.

On the basis of the information obtained from General Electric during hearings regarding the citation and other information obtained during the Administration's investigation, a determination was made that legal action against General Electric was not warranted.

HEW's Assistant General Counsel, Food and Drug Division, was not consulted regarding need for legal action in this case. According to the Assistant General Counsel, there may have been a basis for prosecution against General Electric.

A complete review of the case, however, would be necessary before such a determination could be made. The Assistant General Counsel believed the case was too old to reopen. (See pp. 10 to 15.)

Because determinations as to whether a manufacturer should be prosecuted for misbranding or adulteration violations of the FD&C Act often require technical legal considerations, the Administration's legal counsel should be consulted concerning such determinations. (See pp. 21 and 22.)

Subsequent pacemaker recalls

Since General Electric's 1972 pacemaker recall, General Electric and three other manufacturers--Cordis Corporation, Biotronik Corporation and Vitatron Medical, Incorporated--have recalled about 22,310 pacemakers.

These pacemakers have exhibited a variety of problems, including the presence of moisture which in combination with other factors, affected the pacemaker's performance.

Because manufacturers are not required to notify the Administration of their recalls, the Administration did not become aware of three of the

recalls until 6 to 16 months after they had been initiated.

As of February 1975, the Administration was in the process of investigating these recalls. (See pp. 16 to 18.)

Pacemaker standards

Although cardiac pacemakers have been marketed since about 1960, the Administration had not established standards for their safety, manufacture, distribution and use. Such standards are necessary to help insure that marketed cardiac pacemakers are safe, reliable, and effective.

In May 1974 the Administration awarded a contract for the development of pacemaker standards.

Standards under development do not include a standard dealing with the problem of moisture which affected the performance of many of the pacemakers that were recalled. Inasmuch as moisture was a significant problem, moisture standards should be developed along with inspection guidelines and good manufacturing criteria. See pp. 19 and 20.)

RECOMMENDATION TO THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE

The Secretary, HEW, should direct the Commissioner of the Food and Drug Administration to

--Make a concerted effort to insure compliance with the requirements of the Administration's recall procedures.

--Establish guidelines and provide training needed for the inspection of pacemaker manufacturing facilities and equipment.

--Establish good manufacturing criteria for pacemakers.

--Make a public disclosure through the news media or a statement of facts to all affected parties (i.e., physicians, hospitals, or consumers) to insure timely notification of potentially hazardous products.

--Require the Administration's legal counsel be consulted before a final determination is reached as to whether a manufacturer should be prosecuted for violation of the FD&C Act.

--Establish pacemaker safety and performance standards to reduce or eliminate the risk of injury or illness to potential pacemaker users.

CHAPTER 1

INTRODUCTION

In a letter dated July 2, 1973, the Chairman 1/, Subcommittee on Reorganization, Research, and International Organizations, Committee on Government Operations, United States Senate, advised us that the Subcommittee had received allegations concerning a number of deaths associated with certain malfunctioning implantable cardiac pacemakers that were manufactured and recalled by the General Electric Company (GE), and asked us to review the Food and Drug Administration's (FDA's) activities involving the regulation of cardiac pacemakers. Specifically we were requested to obtain information on FDA's efforts to (1) investigate the GE cardiac pacemaker recall and (2) establish safety and performance standards for cardiac pacemakers.

There are two types of cardiac pacemakers--one is surgically implanted in the human body and the other is used externally. (See illustration of an implantable pacemaker on page 3.) Both types artificially stimulate the heart with electrical impulses to assist the heart in maintaining a normal pulse rate.

Cardiac pacemakers operate on a standby or fixed-rate basis. Standby pacemakers emit electrical impulses to the heart only when needed to compensate for variations in the heart rate. Fixed-rate pacemakers emit electrical impulses to the heart at a constant rate established before the device is placed into use.

Industry studies indicate there are currently about 125,000 users of implantable cardiac pacemakers in the United States and users increase by about 30,000 annually. FDA estimates there are about 15 domestic and foreign manufacturers who market pacemakers in the United States.

FDA REGULATORY AUTHORITY

FDA, a constituent agency of the Department of Health, Education, and Welfare (HEW) is responsible under the Federal Food, Drug, and Cosmetic Act (FD&C Act) (21 U.S.C. 301), for the regulation of medical devices (including cardiac pacemakers) that are shipped in interstate commerce.

The FD&C Act does not provide FDA the authority to require pre-market clearance for medical devices. FDA's

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1/ On January 17, 1975, the Subcommittee Chairman became the Chairman of the Senate Committee on Government Operations.

regulatory control over medical devises is limited to inspections of a manufacturer's facilities, the collection and examination of finished products, and the surveillance of medical devices that have been marketed in interstate commerce.

When FDA considers medical devices to be adulterated or misbranded, it can initiate one or more of the following legal actions through the Department of Justice.

--Prosecute a manufacturer or individual who violates the FD&C Act.

--Enjoin a manufacturer or individual from shipping adulterated or misbranded products in interstate commerce.

--Seize the device when it is introduced into, or while in or after receipt in, interstate commerce.

FDA uses two methods--seizures and recalls--for removing from the market products which are known or suspected to be in violation of the FD&C Act. Seizures require a civil court action and in the case of misbranding violations is limited to the specific quantity and location of the medical device identified in the seizure complaint.

Recalls of products are made by the voluntary action of the manufacturer. A recall can include a manufacturer's correction of products on the market as well as the removal of such products from the market. FDA does not have recall authority.

Because recall actions are voluntary, medical device manufacturers are not required under the FD&C Act to notify FDA of such recalls. Once FDA learns of a recall, it can inspect the manufacturer's facilities, collect and conduct tests on the finished products, and initiate investigations to insure that the recall is effectively implemented.

FDA's Bureau of Medical Devices and Diagnostic Products (BMDDP) 1/ in Rockville, Maryland, administers FDA's program for the regulation of medical devices. BMDDP's responsibility includes (1) coordinating and developing safety and performance standards, (2) establishing and enforcing good manufacturing practice regulations for insuring manufacturing quality control, (3) developing an inspection and enforcement

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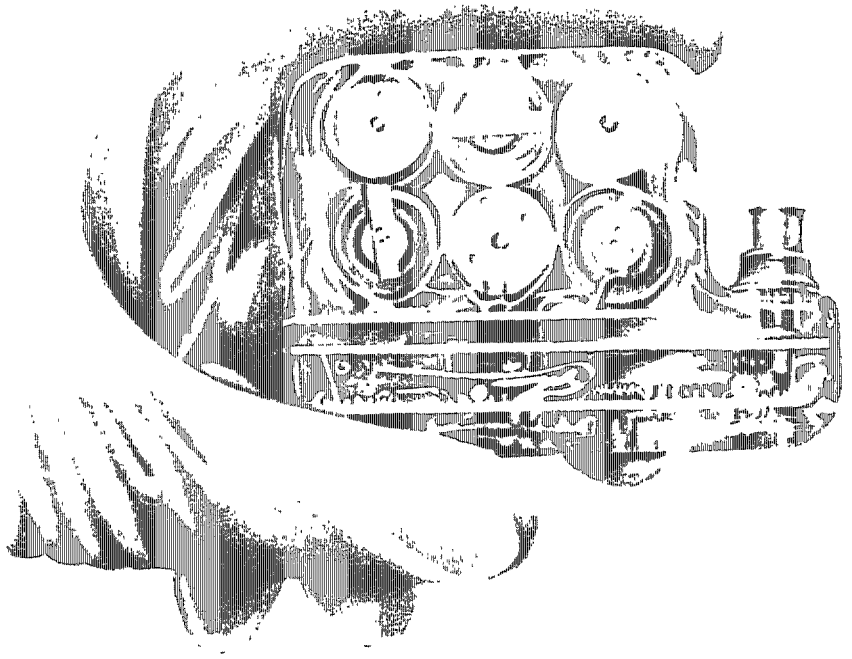
1/ Prior to February 1974, the activities of BMDDP were assigned to the Office of the Associate Commissioner for Medical Affairs.

program for the surveillance of marketed medical devices, and (4) monitoring investigations carried out by FDA's district offices located throughout the United States.

In January and April 1972, GE recalled about 574 implantable standby cardiac pacemakers--model A2072--because of electronic problems with the pacemaker.

LIFE-SIZED ILLUSTRATION OF AN IMPLANTABLE CARDIAC PACEMAKER



CHAPTER 2

CARDIAC PACEMAKER RECALL

FDA's primary objective for monitoring a manufacturer's recall of a product is to determine any potential hazard the product poses to health and to insure that recall actions will be successful in protecting consumers. To achieve this objective, FDA's recall procedures require FDA to take measures to insure that the defective products are promptly removed from the market and the cause of the defect is identified and corrected. FDA did not take such measures in connection with GE's recall of defective cardiac pacemakers.

RECALL PROCEDURES

FDA's recall procedures apply to all FDA regulated products including medical devices, such as cardiac pacemakers. The procedures required FDA to

--inspect the manufacturing facilities,

--collect and examine samples of the recalled product,

--make public disclosure of the recall,

--investigate the effectiveness of the manufacturer's recall in removing a defective product from the market, and inquire into any injuries or complaints related to the recalled product, and

--evaluate the need for prosecution of a manufacturer for violations of the adulteration and misbranding provisions of the FD&C Act.

Inspection of GE's manufacturing facility

The recall procedures required that FDA conduct an in-depth inspection of a manufacturing facility in which the recalled product was produced to determine the basic cause of the recall.

Pursuant to section 704(a) of the FD&C Act, FDA has authority to inspect a facility in which products covered by the act are manufactured for interstate commerce. Such authority covers all pertinent equipment, finished and unfinished materials and containers.

With regard to medical devices, HEW's Assistant General Counsel, Food and Drug Division told us that FDA does not have access to a manufacturer's reports and records bearing

on the safety or effectiveness of such devices or on the adulteration or misbranding of them. (FDA's Inspection Operations Manual provides that FDA may request the manufacturer to provide such material on a voluntary basis, when needed.) According to the Assistant General Counsel, FDA's authority with regard to medical devices is limited to visual inspections of the manufacturing facility. FDA's visual inspection of GE's manufacturing facility, however, was not complete in that it did not include an inspection of the area used for life testing pacemakers.

FDA initiated an investigation of GE's recall of implantable standby cardiac pacemakers after learning of the recall on April 8, 1972, from various newspaper articles. An FDA district office inspector met with GE officials during the period April 11 to April 19, 1972, at GE's manufacturing facilities in Milwaukee, Wisconsin, and obtained certain manufacturing and distribution information pertaining to the defective cardiac pacemakers. GE told the FDA inspector that:

--In November and December 1971, GE received seven reports concerning pacemakers with abnormally high pacing rates. Based on the reports GE determined that the defective pacemakers were manufactured during a nine day production period in June 1971.

--On January 24, 1972, GE sent a "product safety warning letter" to physicians in the United States and Canada who had implanted about 125 pacemakers that were manufactured during the nine day production period. The letter requested that the physicians test the pacemakers and replace those which indicated an abnormally high pacing rate. As an added precaution GE sent the same letter to physicians that had implanted GE pacemakers manufactured six days before and after the suspected nine day production period.

--Subsequently GE received a report on March 14, 1972, from a hospital which indicated that similar high pacing rate problems existed in pacemakers manufactured outside the suspected manufacturing period.

--As additional reports on high pacing rate problems were received, GE considered the need for an expanded recall and initiated a study at its Corporate Research and Development Center to develop information concerning the probable failure rate of the pacemakers. The study report received by GE on March 25, 1972, showed that the eventual failure rate of the entire group of pacemakers involved in the recall might reach a level as high as 20 percent.

--As of April 1972, GE received 22 reports, including the seven reports received in November and December 1971, concerning abnormally high pacing rates in pacemakers. Subsequently, GE issued a second product safety warning letter, dated April 1, 1972, expanding its recall to include all implantable standby pacemakers manufactured during the period June 6 to September 8, 1971. In its letter, GE offerred to replace the recalled pacemakers free and to cover all medical and surgical costs associated with the replacement provided the physician used a GE pacemaker as a replacement and returned the disimplanted pacemaker to GE.

--On April 3, 1972, GE alerted its district sales managers of the recall. On April 4, and 10, 1972, GE advised its sales managers to re-emphasize to physicians GE's position regarding replacement of the recalled pacemakers. GE also requested its sales representatives to visit each physician involved to establish a time schedule for the replacement of the recalled pacemakers.

According to GE, 574 pacemakers were involved in the recall. Of these, 352 pacemakers were implanted in people living in the United States and the remaining 222 pacemakers were distributed to foreign countries or held in GE's inventory. (See app. I for accounting of the recalled pacemakers at the time FDA completed its investigation in June 1973.)

According to GE, the high pacing rate was due to a shunt (short-circuit) caused by a dendritic growth of copper between the circuit runs on the paper epoxy circuit board in the pacemaker. GE told FDA that although GE had not determined the reason for the dendritic growth, it believed that it may have been due to the use in June 1971 of tin-plated circuit runs on the pacemaker circuit boards. GE indicated that the presence of moisture on the tin-plated circuit runs resulted in the pacemaker's shunt. Prior to June 1971, the pacemaker circuit boards did not have tin-plated circuit runs.

GE suggested to BMDDP that an FDA representative with sufficient technical background meet with GE to discuss the technical issues surrounding the problem. FDA Minneapolis District Office officials told us that FDA has not issued good manufacturing criteria for pacemakers and FDA inspectors lacked adequate guidelines, training, and experience to assess technical issues involving complex medical devices such as cardiac pacemakers.

On May 16, 1972, an FDA Minneapolis District Office Inspector accompanied by a technical representative from BMDDP, conducted a visual inspection of GE's pacemaker manufacturing facilities. FDA's inspection did not include GE's life-testing area used to test new pacemakers in a saline bath simulating the environment of the human body and to test returned pacemakers.

The BMDDP technical representative stated that inspection of this area was important for determining the cause of the defect in GE's pacemaker. Because GE considered the research being conducted in this area to be proprietary, it required FDA to obtain approval from GE's legal counsel or its facility manager to inspect the area. According to the Acting Director of the BMDPP's Division of Compliance, such approval was not requested because, contrary to the view of BMDDP's technical representative, very little would have been gained by FDA's visual inspection of GE's life-testing area.

Collection and examination of pacemaker samples

FDA's recall procedures require that any FDA district office involved in a recall promptly collect and examine physical samples of the recalled product. Where the collection of physical samples is not possible, the procedures require that a documentary sample be collected. A documentary sample consists of records and documents including labels, photos of the recalled product, copies of invoices, and affidavits pertaining to the recalled product.

According to FDA's Inspection Operations Manual the collection and examination of a recalled product can provide tangible evidence of adulteration or misbranding and could serve as the principal basis for determining the need for regulatory action.

FDA did not collect and examine samples of GE's recalled pacemakers. A physician who had disimplanted a recalled pacemaker provided it to FDA, however, FDA did not examine it. FDA Minneapolis District Office officials advised us that laboratory tests or analyses were not conducted on the disimplanted pacemaker because the district office did not have any in-house scientific testing capability.

The Acting Director of BMDDP's Division of Compliance told us that FDA did not acquire samples, costing about $600 each, because of a lack of (1) financial resources, (2) testing capabilities, and (3) standards for pacemaker safety

and reliability. (Pacemaker standards are discussed in Chapter 4.)

The Acting Director said that he did not believe that FDA needed to examine samples of the recalled pacemaker to determine that it was defective, as GE had informed FDA that several of the recalled pacemakers would fail. Although a manufacturer reports a problem concerning its products, we believe FDA should examine samples of the recalled product to determine the need for regulatory action.

Public disclosure

At the time of GE's pacemaker recall, FDA's recall procedures required FDA in all life threatening situations to (1) place a notice of the recall on a recall list for distribution to the trade press and selected Government agencies and (2) issue a public warning through the news media. Although GE's pacemaker recall involved a life-threatening situation, FDA did not comply with its procedures.

The Acting Director of BMDDP's Division of Compliance told us that a notice of the GE pacemaker recall was not placed on FDA's recall list because of an administrative oversight.

The Acting Director said FDA did not issue a public warning through the news media because GE had already issued a warning to each pacemaker user's physician. (See p. 9.) We noted, however, that one pacemaker user was not located through GE's efforts.

The Acting Director said that:

> "FDA did not believe a public notice was needed. The recall had been announced and widely publicized and at the time we became involved, most of the devices to be recalled had been technically recalled.
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> "Our major concern at that point in time was to assure that every patient had been accounted for so as to insure that the recall was 100% effective. * * * In any event, whether to issue a press release is a decision made at the discretion of the agency. In this case, we believe there was no benefit to the consumer to be gained by a press release.
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> "Each unit was identified by serial numbers and we were assured by the firm that it could trace each device to its consignee [i.e., physicians and

hospitals] thus enabling the firm to notify each consignee directly for return of the device. Moreover, we believed that to issue a general warning would cause unnecessary concern and panic to those persons with pacemakers from other manufacturers and who in turn would unnecessarily bother their doctors as to which pacemakers they had implanted.

"It was partly as a result of this unique incident * * * that the FDA reconsidered its recall policy and establish new procedures."

In September 1973 FDA revised its recall procedures with respect to public disclosure of a recalled product that presents a threat to consumer safety. The revised procedures provide that public warnings be issued through the news media only when there is a need in the public interest to alert institutions, professional and industry groups, or other affected persons. In lieu of a public warning, FDA may issue a statement of facts to the appropriate segment of the public affected by a recalled product without alarming others not involved in the recall.

Because of the concern that such procedures could withhold from the public vital information concerning a defective and potentially hazardous product, legislation (H.R. 216, 94th Congress, and H.R. 10916, 93d Congress) has been introduced to prohibit FDA's withholding from the public information regarding the trade name, trademark, manufacturer, area of distribution, and name of any recalled product.

Investigation of effectiveness of GE's recall

FDA's recall procedures require that FDA investigate the effectiveness of a manufacturer's product recall. In a case involving an imminent hazard to health, the recall procedures required FDA to contact all of the product consignees to insure that the consignees had received notification of the recall and to develop information concerning injuries and complaints associated with the product. FDA did not contact all of GE's pacemaker consignees, but found at least five physician consignees had not received notification of the recall from GE.

On April 20, 1972, BMDDP told the FDA Minneapolis District Office that in lieu of verifying that each physician consignee had been informed of the problem, the serial numbers of all pacemakers returned to GE's manufacturing facility could be checked against the list of pacemakers that were shipped.

In a telegram dated May 3, 1972, BMDDP reiterated that the district office inspectors did not have to contact all physician consignees but could rely on information provided by GE concerning disposition of the recalled pacemakers, if the inspectors considered such information to be accurate. BMDDP advised the FDA Minneapolis District Office that GE pacemaker users and their relatives were not to be visited under any circumstances.

The Acting Director of BMDPP's Division of Compliance told us that FDA accounted for the recalled pacemakers as they were returned to GE's manufacturing facility. These pacemakers were returned to GE over a 14-month period, April 1972 to June 1973. This procedure, in our view seems to have delayed FDA's determination concerning whether all physician consignees were notified of the recall and exposed pacemaker users to an unnecessary health risk.

On the basis of its investigation of certain deaths and injuries, FDA found that five physician consignees did not receive GE's product safety warning letter. FDA did not take any further action to insure that all physician consignees were made aware of the recall. FDA did not contact all physician consignees, and, therefore, did not develop complete information on injuries and deaths associated with the 352 pacemakers that were distributed in the United States.

FDA made investigations involving 68 of the recalled pacemakers. According to FDA records, seven deaths and two injuries were attributed to the defective pacemakers. FDA did not conduct investigations to determine whether any injuries or deaths were associated with the remaining 284 recalled pacemakers that were distributed in the United States.

FDA evaluation of need for regulatory action

On July 7, 1972, an FDA Minneapolis District Office official submitted to BMDDP, medical reports and records on four deaths, including affidavits from physicians attributing malfunctioning pacemakers as a major causative factor of death. On the basis of this and other information, the District Office official concluded, that prosecution action against GE appeared warranted because:

> "* * * General Electric's lack of proper quality control caused deaths of some patients and much mental and physical anguish to other patients in whom replacement devices were required. It also appears that General Electric is concerned in

maintaining a high-profit margin on the units in that they attempted to get by with a cheaper circuitry board * * *."

On August 7, 1972, BMDDP's Division of Compliance advised the Minneapolis District Office that a citation could be issued against GE charging:

> "* * * that the products are adulterated under [section] 501(c) [of the FD&C Act] in that their quality falls below that which they purport or are represented to possess; and that the products are misbranded under [section] 502(f)(2) [of the act] in that the labeling fails to bear adequate warnings against use in those pathological conditions or by children where its use may be dangerous to health, or against unsafe dosage or methods or duration of administration or application, in such manner and form, as are necessary for the protection of users and [section] 502(j) [of the act] in that the device is dangerous to health when used in the dosage, or with the frequency or duration prescribed, recommended, or suggested in the labeling thereof."

On August 22, 1972, FDA's Minneapolis District Office issued a "Charge Sheet" and a "Notice of Hearing" citing GE for violations of the adulteration and misbranding provisions of the FD&C Act involving four of the recalled pacemakers that were associated with the users' deaths.

A hearing was held at FDA's Minneapolis District Office on October 17, 1972, to provide GE an opportunity to show cause why it should not be prosecuted. During the hearings GE stated that the pacemaker malfunction resulted from a unique electronic phenomenon. According to GE, the most plausible hypothesis for the formation of dendrites on the circuit boards in the recalled pacemakers was that

> "* * * this particular group of tin-plated circuit boards for some reason required the use of more solder flux than usual to make a good joint and also required more mechanical abrasions to properly clean the soldering flux. These unusual conditions led to a situation where the normal cleaning processing employed * * * did not remove the last trace of solder flux. The [presence of] solder flux in combination with other facts could lead to * * * incomplete bonding [of the epoxy on the circuit boards].

"After the pacemaker is implanted and has a source of moisture, this moisture moves then to the region where there is an improper bond, provides a solvent medium to both ions and copper, and to provide a liquid medium for the copper and in combination for the presence of special conditions which could result in dendritic growth. * * *."

Moreover, GE stated that the problem could not have been foreseen and that when GE began its investigation of the problem it was handicapped by the fact that little scientific information was available concerning the unique electronic phenomenon. GE officials concluded that: (1) the pacemaker malfunction was not a manufacturing error; (2) GE took responsible action as soon as it received information concerning problems with its pacemaker; and (3) GE never sacrificed safety considerations for economic considerations during the recall.

According to the Acting Director of BMDDP's Division of Compliance, FDA contacted the National Bureau of Standards concerning the electronic phenomenon attributed as the problem with GE's pacemaker. The Acting Director said that the Bureau advised FDA that the electronic phenomenon was possible but not unique. According to the Acting Director, FDA considered the electronic phenomenon unique to cardiac pacemakers as it was the first time that FDA learned such a phenomenon had occurred in cardiac pacemakers. BMDDP did not contact other pacemaker manufacturers to determine whether they experienced similar dendrite problems with the internal circuitry of their pacemakers.

In December 1972 FDA requested GE to furnish information concerning (1) the reasons dendrites had formed on tin-plated circuit boards but not on non-tin-plated circuit boards in GE's pacemakers and (2) GE's pacemaker life testing prior to, during, and after the recall. GE informed FDA that dendrites had also formed on the non-tin-plated circuit boards in pacemakers that were manufactured prior to June 1971. According to GE, the overall failure rate for non-tin-plated circuit board pacemakers was 3.6 percent after an average implant time of 14 months. The failure rate for pacemakers using tin-plated circuit boards was 32 percent. Therefore, GE believed the primary cause for the increased failure rate was due to the introduction of tin-plated circuit boards.

GE advised FDA that it made certain manufacturing changes to correct the problem. FDA did not evaluate these changes to determine their adequacy.

Also, GE provided FDA with information concerning its pacemaker life testing procedures. GE explained that under its testing procedures that were in effect in 1971 the pacemakers selected for life testing were primarily those that had been rejected during the manufacturing process. Because of the method of selection, none of the pacemakers subjected to life testing during 1971 were drawn from the production period in which the recalled pacemakers were produced. In 1972 GE established a new procedure requiring two pacemakers from each week's production to be subjected to long term life testing and monitored for quality and reliability.

According to the Acting Director of BMDDP's Division of Compliance, FDA did not review GE's quality control procedures prior to the recall and did not obtain sufficient information concerning GE's 1972 procedures to permit an adequate evaluation of them.

On the basis of the information obtained from GE and other sources during its investigation, BMDDP determined that no further investigation of GE's recalled pacemakers was necessary and on July 26, 1973, advised FDA's Minneapolis District Office that prosecution against GE was not warranted because:

> "1) In determining whether punitive litigation in the form of a prosecution is the proper course of action against the firm and its officers, we would have to be able to establish for the Court:
>
> > "a) [that] the quality and quantity of the evidence indicates that the articles which were shipped were adulterated and/or misbranded prior to, while in, or after receipt in interstate commerce;
> >
> > "b) whether these pacemakers were manufactured under controls, standards and technology which were prevalent in the industry at that time;
> >
> > "c) whether the benefit/risk factors were such as to preclude any other alternatives, but to ship those articles manufactured under the then existing state of technology in lieu of depriving potential users of a life sustaining device.
>
> "2) The four samples upon which the citation was based and upon which the prosecution would

be predicated, are not in themselves sufficient to establish that the articles were, in fact, adulterated, misbranded or in any way defective at the time they were introduced into, while in, or after receipt in interstate commerce.

"While we have an a priori cause and effect relationship of a faulty device being obtained from a deceased patient, we have no evidence that the firm did not maintain a high standard of quality control in manufacturing their devices.

"We would be in a tenuous position to show that the death was directly attributable to the malfunction of the device, and that the default was not due to medical judgment, surgical procedure or normal wear.

"On the contrary, the devices did in fact maintain the life of the patients for a period of time.

"3) Additionally, no official * * * standards existed upon which the government can contend that the firm did not adhere to.

"4) The problem of benefit/risk ratio could be a valid raised issue by the Court.

"5) While intent is not a question in the matter of prosecution, it does reveal the interests of the firm in this matter. The evidence before us does not indicate that the firm was negligent, fraudulent, or capricious of the public health. On the contrary, the firm took immediate and swift action in instituting a recall and replacing pacemakers which may have been faulty. We have received no further reports of malfunction or defects since that time."

HEW's Assistant General Counsel, Food and Drug Division, was not consulted regarding the need for prosecution action in this case.

We discussed BMDDP's July 26, 1973, memorandum with the Assistant General Counsel. According to the Assistant General Counsel, the Government had to prove for the courts only that the articles which were shipped were adulterated or misbranded prior to, while in, or after receipt in

intertate commerce. The Assistant General Counsel stated that the remaining views expressed in BMDDP's memorandum were irrelevant in considering the justification for prosecution. According to the Assistant General Counsel, there may have been a basis for prosecution against GE, however, a complete review of the case would be necessary before such a determination could be made. He believed that the case was too old to reopen.

CHAPTER 3

SUBSEQUENT PACEMAKER RECALLS

Since GE's 1972 pacemaker recall, GE and three other manufacturers--Cordis Corporation, Biotronik Corporation, and Vitatron Medical, Incorporated--have recalled about 22,310 pacemakers. According to a BMDDP official, these pacemakers have exhibited a variety of problems, including the presence of moisture which in combination with other factors, affected the pacemaker's performance. Because manufacturers are not required to notify FDA of their recalls, FDA did not become aware of three of the recalls until 6 to 16 months after they had been initiated. As of February 1975, FDA was in the process of investigating these recalls.

GE'S 1974 RECALL

In addition to GE's recall of its standby pacemaker (model A2072), GE, in June 1974, recalled about 2,000 fixed-rate pacemakers (model A2073). The recall was initiated after three pacemakers failed because of excessive pacing rates caused by moisture on the pacemaker's circuitry.

On June 8, 1974, GE began a world-wide recall of about 161 fixed-rate pacemakers manufactured in 1971. Prior to the recall GE met with FDA inspectors and told the inspectors that the dendritic growths in the fixed-rate pacemakers were similar to those causing high rate pacing in GE's previously recalled standby pacemakers and that the failure mode, mechanics of the failure, and the technical cause were identical to that previously experienced in GE's standby pacemakers.

An FDA inspection report concerning the recall notes that because GE did not fully understand the precise cause or combination of factors leading to dendritic growth, GE was not certain that the scope of its recall was adequate. Therefore, on June 18, 1974, GE expanded its recall to include all 2,000 fixed-rate model A2073 pacemakers that were manufactured since 1971.

On September 4, 1974, GE met with FDA to discuss its future plans with respect to the dendrite problem. In this meeting, GE explained that the formation of dendrites could cause the high pacing problem to occur by about the thirtieth month of implantation. Accordingly, GE officials advised FDA that GE plans to recommend to physician consignees that they consider replacing the defective pacemakers not later than the thirtieth month of implantation. At the conclusion

of this meeting, FDA requested GE to provide additional information, regarding the performance and reliability of the pacemaker during the 30-month implantation period.

After obtaining and reviewing such information the Acting Director of BMDDP advised GE on November 27, 1974, that the information did not support a 30-month implantation period because the risk to the patient would be too high if the pacemakers remained implanted for that period of time. The information, according to the Acting Director of BMDDP, did not support an implantation period longer than 24 months and BMDDP, therefore, suggested to GE that the implantation period not exceed 20 to 24 months in order to provide an adequate margin of safety for the user. In accordance with the Acting Director's suggestion, GE officials advised BMDDP that GE issued followup recall letters on February 1, 1975, to all physician consignees of GE's fixed-rate pacemaker and recommended that the pacemaker be be disimplanted not later than 22 to 24 months after the date of implantation.

CORDIS CORPORATION'S RECALLS

In June and October 1973 and December 1974 the Cordis Corporation, a manufacturer located in Miami, Florida, recalled about 14,050, 120, and 4,290 pacemakers respectively. Cordis did not notify FDA of the June and October 1973 recalls until October 1974, about 16 months after its initial recall. Cordis notified FDA of the December 1974 recall at about the time it was initiated.

With regard to the 14,050 pacemakers, a BMDDP memorandum dated December 30, 1974, stated that they were manufactured in 1971 and 1972 and were being recalled because the presence of moisture on the pacemaker's circuitry was causing it to malfunction. The memorandum indicated that about 12,000, or 85 percent, of these pacemakers were still implanted in the pacemaker users. As of February 1975, similar information regarding the disposition of the remaining 4,410 pacemakers was not available at BMDDP.

BIOTRONIK CORPORATION'S RECALL

In February 1974 the Biotronik Corporation of Germany recalled about 1,345 pacemakers which were imported into the United States between May 1972 and April 1973. FDA learned of this recall in September 1974, about 7 months after the recall was initiated. An FDA inspector's telegram dated October 3, 1974, to BMDDP stated that moisture leaking through the epoxy encapsulation caused the pacemakers to malfunction.

According to Biotronik officials, the problem had not been detected because adequate manufacturing quality controls did not exist. Biotronik officials told BMDDP that since the recall, Biotronik has instituted an accelerated life-testing procedure which should identify such problems in the future.

VITATRON MEDICAL, INCORPORATED RECALL

In June 1974, Vitatron Medical, Incorporated located in Dieran, Holland recalled about 506 pacemakers that were imported into the United States, due to pacemaker failures resulting from defective batteries. FDA learned of the recall in December 1974, about 6 months after it was initiated. As of January 1975, 141 pacemakers were returned to Vitatron and about 50 pacemakers remained implanted. FDA records did not show the disposition of the remaining 315 pacemakers.

CHAPTER 4

PACEMAKER STANDARDS

The Subcommittee Chairman requested that we obtain information concerning FDA's efforts to develop pacemaker standards, including standards for outside interference, resterilization and reuse, warranties, and hermetically sealing of pacemakers to protect the circuitry against moisture.

Although cardiac pacemakers have been marketed since about 1960, FDA has not established standards for their safety, manufacture, distribution and use. Such standards are necessary to help insure that marketed cardiac pacemakers are safe, reliable, and effective.

In March 1972 HEW's Assistant Secretary for Health and Scientific Affairs established the Panel on Review of Cardiovascular Medical Devices to (1) review and evaluate available information concerning the safety, effectiveness, and reliability of cardiovascular devices currently in use in order to determine the regulatory category most appropriate for control of these devices, (2) identify the need for specific standards concerning those devices which can best be controlled by establishing standards, and (3) recommend solutions to specific problems with devices. The panel consists of seven members selected from the medical profession, the medical device industry, the engineering and scientific communities, and a consumer.

Cardiovascular devices were to be classified into the following regulatory categories:

--those which can adequately be controlled by general labeling requirements,

--those requiring safety and efficacy standards to reduce or eliminate unreasonable risk of injury or illness, and

--those requiring premarket scientific review before being marketed to assure the products' safety and effectiveness, and to prevent unreasonable risk of injury or illness.

Since its first meeting in September 1972, the panel has classified about 300 cardiovascular medical devices and classes of devices which are representative of the entire cardiovascular field into the various regulatory categories. The panel placed cardiac pacemakers into the premarket scientific review category pending development of pacemaker standards.

Beginning July 23, 1973, the panel held several meetings with the Association for the Advancement of Medical Instrumentation to discuss the status of pacemaker standards development. As a result of those meetings, the panel recommended that FDA assign a high priority to the development of pacemaker standards.

On May 16, 1974, FDA awarded a contract to the Association for the development of pacemaker standards including (1) labeling, (2) standard test procedures, (3) performance standards, (4) packaging and handling, and (5) a dictionary or glossary of terms used within the standards.

Performance standards to be developed under the contract are to cover outside electromagnetic interference and methods for establishing a pacemaker's useful life expectancy. However, the contract does not provide for the development of standards for sealing pacemakers or resterilization and reuse of pacemakers.

The Acting Director of BMDDP's Division of Medical Device Standards and Research told us that a standard for hermetically sealing--a process used by a number of manufacturers to protect the pacemaker circuitry from moisture--was not being developed as FDA believed such a standard might restrain manufacturers' efforts in developing a solution to the moisture problem. The Acting Director told us that standards for resterilization and reuse of pacemakers are not being developed under the contract because pacemakers are not generally reused.

The work under FDA's contract is expected to be completed in August 1975. According to the Acting Director, FDA will not issue standards for several months after the contract is completed.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

FDA needs to strengthen its regulation of implantable cardiac pacemakers. Since GE's 1972 recall, GE and three other manufacturers have recalled about 22,310 pacemakers many of which exhibited the same basic problem--shunting due to accumulation of moisture on the pacemakers circuitry. When the problem was first noted in the GE standby pacemaker in 1972, FDA did not make a thorough study of the problem but accepted GE's explanation that it was the result of a unique electronic phenomenon. Subsequent pacemaker recalls by other manufacturers for basically the same problem indicates that the problem could be widespread throughout the pacemaker industry.

Because defective pacemakers present a serious risk to consumer's health, it would seem especially important for FDA to take prompt, effective measures during a reall to insure the safety of the consumer. With regard to GE's 1972 pacemaker recall, FDA did not fully carry out the requirements of its recall procedures which are intended to minimize risks to consumers.

Although required by its recall procedures, FDA did not (1) make a complete visual inspection of GE's manufacturing facility to determine the cause of the defect, (2) collect and examine samples of the recalled GE standby pacemaker to determine the need for regulatory action and (3) make a public disclosure of the recall and verify that all physician consignees and pacemaker users received notification of the recall. Also, the lack of FDA inspection guidelines, safety and performance standards and good manufacturing criteria for complex medical devices such as pacemakers limited the effectiveness of FDA's investigation of the pacemaker recall.

Standards presently under development do not include a standard dealing with the problem of moisture which affected the performance of many pacemakers that were recalled. Inasmuch as moisture was a significant problem, we believe moisture standards should be developed along with inspection guidelines and good manufacturing criteria.

FDA's legal counsel was not consulted regarding the legal requirements for enforcing the misbranding and adulteration provisions of the FD&C Act. Because determinations as to whether a manufacturer should be prosecuted for misbranding or adulteration violations of the FD&C Act often require technical legal considerations, FDA operating

personnel should consult with legal counsel concerning such determinations.

FDA lacks authority to review a manufacturer's records and data relating to the production and distribution of pacemakers and to require manufacturers to promptly notify FDA of all recalls. Such authority could strengthen FDA's regulation of pacemakers. Legislation introduced in the 94th Congress (S. 510) would provide FDA with such authority.

RECOMMENDATION TO THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE

We recommend that the Secretary, HEW, direct the Commissioner, FDA, to

- --Make a concerted effort to insure that the requirements of FDA's recall procedures are complied with.
- --Establish guidelines and provide training needed for FDA inspections of pacemaker manufacturing facilities and equipment.
- --Establish good manufacturing criteria for pacemakers.
- --Make a public disclosure through the news media or a statement of facts to all affected parties (i.e., physicians, hospitals, or consumers) to insure timely notification of potentially hazardous products.
- --Require that FDA's legal counsel be consulted before a final determination is reached as to whether a manufacturer should be prosecuted for violation of the FD&C Act.
- --Establish pacemaker safety and performance standards to reduce or eliminate the risk of injury or illness to potential pacemaker users.

CHAPTER 6

SCOPE OF REVIEW

We reviewed pertinent legislation, regulations, policies, procedures, and practices relating to FDA's regulation of medical devices; examined records and reports on FDA's investigation of cardiac pacemaker recalls by GE and other manufacturers; and examined records and reports on FDA's efforts to develop standards governing the safety, efficacy, manufacture, distribution, and use of cardiac pacemakers.

We also interviewed officials at FDA Headquarters in Rockville, Maryland, and its Minneapolis District Office, who were primarily responsible for carrying out FDA's investigation of GE's pacemaker recall, and obtained the views of HEW's Assistant General Counsel, Food and Drug Division, concerning the basis for prosecution action against GE and the feasibility of taking such action.

ACCOUNTING OF PACEMAKERS SUBJECT TO GE's 1972 RECALL AS OF JUNE 1973

GE PACEMAKERS DISTRIBUTED IN UNITED STATES	
Physically accounted for by FDA when returned to GE's manufacturing facility	274
Pacemaker user died - pacemaker buried with patient	43
Pacemaker user died - pacemaker disposition unknown	4
Pacemaker user died - pacemaker retained by physician	2
Pacemaker user never located	1
Pacemaker lost or misplaced by hospital - return not expected	5
Pacemaker retained by hospital for possible litigation against GE	1
Pacemaker disposed of by hospital - return not expected	2
Physician would not disimplant recalled pacemaker	10
Pacemaker replaced by unit other than GE - return not expected	8
Pacemaker returned to GE - not physically accounted for by FDA	2
	352
GE PACEMAKERS DISTRIBUTED IN COUNTRIES OTHER THAN THE UNITED STATES	
Physically accounted for by FDA when returned to GE's manufacturing facility	105
Returned to GE - not physically accounted for by FDA	2
Physician would not disimplant recalled pacemaker	2
Pacemaker user died - buried with patient	1
Pacemaker disimplanted from user prior to recall	7
In GE's stock - not implanted	1
Pacemaker held by United States Customs	1
Unaccounted for by FDA	37
	156
IN GE INVENTORY AT TIME OF RECALL	
Physically accounted for by FDA at GE's manufacturing facility	65
Lost in mail upon return from GE's sales office	1
	66
Total	574

NOTE: We developed this schedule on the basis of records available at FDA's Minneapolis District Office.

APPENDIX II

PRINCIPAL OFFICIALS OF THE DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE RESPONSIBLE FOR ADMINISTRATION OF ACTIVITIES DISCUSSED IN THIS REPORT

	Tenure of office	
	From	To
SECRETARY OF HEALTH, EDUCATION AND WELFARE:		
Caspar W. Weinberger	Feb. 1973	Present
Elliott L. Richardson	June 1970	Feb. 1973
ASSISTANT SECRETARY FOR HEALTH (note a):		
Theodore Cooper (acting)	Jan. 1975	Present
Charles C. Edwards	Mar. 1973	Jan. 1975
Richard L. Seggel (acting)	Dec. 1972	Mar. 1973
Merlin K. Duval, Jr.	July 1971	Dec. 1972
Roger O. Egeberg	July 1969	July 1971
COMMISSIONER, FOOD AND DRUG ADMINISTRATION:		
Alexander Schmidt	July 1973	Present
Sherwin Gardner (acting)	Mar. 1973	July 1973
Charles C. Edwards	Feb. 1970	Mar. 1973
ASSOCIATE COMMISSIONER FOR MEDICAL AFFAIRS		
John Jennings	Sept. 1970	Present
DIRECTOR, BUREAU OF MEDICAL DEVICES AND DIAGNOSTIC PRODUCTS (note b):		
David M. Link (acting)	Feb. 1974	Present

a/ Until December 1972, the title of this position was Assistant Secretary (Health and Scientific Affairs).

b/ See footnote 1, p. 2.)

[illegible]
[illegible]