ONLINE FIRST | HEALTH CARE REFORM

Medical Device Recalls and the FDA Approval Process

Diana M. Zuckerman, PhD; Paul Brown, BS; Steven E. Nissen, MD

Background: Unlike prescription drugs, medical devices are reviewed by the US Food and Drug Administration (FDA) using 2 alternative regulatory standards: (1) premarket approval (PMA), which requires clinical testing and inspections; or (2) the 510(k) process, which requires that the device be similar to a device already marketed (*predicate* device). The second standard is intended for devices that the FDA deems to involve low or moderate risk.

Methods: We analyzed the FDA's high-risk List of Device Recalls from 2005 through 2009. Using FDA data, we determined whether the recalled devices were approved by the more rigorous (PMA) process, the 510(k) process, or were exempt from FDA review.

Results: There were 113 recalls from 2005 through 2009 that the FDA determined could cause serious health problems or death. Only 21 of the 113 devices had been approved through the PMA process (19%). Eighty were cleared through the 510(k) process (71%), and an additional 8 were exempt from any FDA regulation (7%). Cardiovascular devices comprised the largest recall category, with 35 of the high-risk recalls (31%); two-thirds were cleared by the 510(k) process (66%; n=23). Fifty-one percent of the high-risk recalls were in 5 other device categories: general hospital, anesthesiology, clinical chemistry, neurology, or ophthalmology.

Conclusions: Most medical devices recalled for life-threatening or very serious hazards were originally cleared for market using the less stringent 510(k) process or were considered so low risk that they were exempt from review (78%). These findings suggest that reform of the regulatory process is needed to ensure the safety of medical devices.

Arch Intern Med. 2011;171(11):1006-1011.
Published online February 14, 2011.
doi:10.1001/archinternmed.2011.30

Author Affiliations: National Research Center for Women & Families, Washington, DC (Dr Zuckerman and Mr Brown); Department of Cardiovascular Medicine, Cleveland Clinic, Cleveland, Ohio (Dr Nissen).

In 1938, when the US Congress first mandated that medical products demonstrate safety and effectiveness, the law applied only to drugs, not to medical devices. Congress did not give the US Food and Drug Administration (FDA) the authority to regulate all medical devices until 1976, when it amended the Food, Drug, and Cosmetics Act in response to deaths and infertility caused by the Dalkon Shield and other contraceptive intrauterine devices. Congress and the FDA weighed 2 competing goals during passage of this legislation: providing "the public reasonable assurances of safe and effective devices"[1(p1339)] while avoiding "overregulation"[1(p1339)] of the industry.

See Invited Commentary at end of article

The 1976 law included a premarket approval (PMA) process for devices that is similar to the new drug application process used for pharmaceuticals. Submissions for PMA require extensive testing, including "valid scientific evidence"[2(p2)] that "provide[s] reasonable assurance that the device is safe and effective for its intended use."[2(p2)] The PMA process was developed as the approval pathway for medical devices that "support or sustain human life, are of substantial importance in preventing impairment of human health, or which present a potential, unreasonable risk of illness or injury."[2(p2)]

CME available online at www.jamaarchivescme.com and questions on page 970

Thousands of devices were already marketed in 1976, so Congress included an alternative pathway to the PMA known as the 510(k) provision, which was intended to provide a less burdensome route to enable newer versions of existing devices to enter the market. The 510(k) pathway did not require clinical trials or manufacturing inspections to demonstrate safety

©2011 American Medical Association. All rights reserved.

Downloaded From: http://jamanetwork.com/ on 05/19/2013

and efficacy. Instead, the sponsor was required only to demonstrate that the device was *substantially equivalent* in materials, purpose, and mechanism of action to another device that was already on the market in May 1976. The previous device served as the *predicate* device with which the new one would be compared. This approach was justified as a way to give manufacturers the opportunity to make small improvements on the devices already on the market and to allow companies with new products to compete with very similar devices without using the more extensive PMA process. If the FDA determined that the product was reasonably safe and effective according to the 510(k) review, it was said to be *cleared for market* rather than *approved*.

Former FDA officials explain that in 1976, relatively few medical devices were permanently implanted or intended to sustain life.[3] The 510(k) process was specifically intended for devices with less need for scientific scrutiny, such as surgical gloves and hearing aids. At first, 510(k) reviews were easy for the FDA to conduct because the new devices were so similar to the devices already on the market, but the system was quickly challenged as new devices changed more dramatically and became more complex.[3] The FDA did not have the resources to develop performance standards for new moderate-risk devices or to shift more devices to the much more stringent and time-consuming PMA process.[3]

Instead, the opposite trend occurred. In an era of aggressive deregulation, the Medical Device User Fee and Modernization Act of 2002 (MDUFMA) was passed by Congress, signed by President Bush, and interpreted by the FDA to shift the regulatory standard to "the least burdensome approach in all areas of medical device regulation."[4(p4)] Subsequently, the definition of *substantially equivalent* was modified to include products made from different materials and using a different mechanism of action if they were determined to have a similar safety profile. Since clinical trials are not required for 510(k) clearance, approval of devices would be based on biomaterials testing or other standards. Furthermore, predicate devices no longer were limited to products already on the market prior to May 1976 but could include devices cleared through the 510(k) or PMA process. In recent years, the FDA has used the 510(k) provision as the dominant mechanism for new device *clearance*, reviewing only 1% of medical devices by its more rigorous PMA process.[5] The present study was designed to examine how often the different approval or clearance processes were used for medical devices that were subsequently recalled for life-threatening problems.

METHODS

FDA CLASSES OF DEVICES AND STANDARDS OF CLEARANCE

For this study, we based our analysis on FDA assignments of medical devices to 1 of 3 classes "based on the level of control necessary to assure the safety and effectiveness of the device"[6(p1)] and on the level of risk the device poses to patients. Class I devices involve the lowest risk and include items such as tongue depressors, bandages, and crutches. Class II devices, such as electrocardiographs, contact lens solutions, hearing aids, and drills for orthopedic applications, involve intermediate risk. And Class III devices are defined by the FDA to pose the greatest potential risk and include such items as implantable pacemakers, stents, heart valves, and human immunodeficiency virus diagnostic tests. Although implants and devices that prevent impairment of health are supposed to be Class III, many hip and knee implants are designated as Class II.

Most Class I devices and some Class II devices are exempt from premarket review and most good manufacturing practices regulations.[6] Companies need not apply to the FDA for review or clearance for exempt devices but merely need to notify the FDA that they are selling the products. Class II devices considered to pose intermediate risk are reviewed through the 510(k) premarket notification process. Class III devices, which are implantable or life-sustaining devices, were intended by law to require the more rigorous PMA review process.[5]

In 2007, Congress asked the Government Accountability Office (GAO) to review the 510(k) process. The resulting 2009 GAO report described the 510(k) process as less stringent, faster, and less expensive than the PMA process and concluded that 66% of Class III submissions cleared through the 510(k) process in recent years were "implantable, life sustaining, or of significant risk,"[5(p21)] which the GAO pointed out by law should have been reviewed through the more rigorous PMA process instead.[5] The GAO noted that while the FDA had committed to stop clearing Class III devices through the 510(k) process more than 14 years earlier, the agency continued this practice.[5] In addition, the GAO reported that of the 10 670 submissions for Class II devices that the FDA cleared through the 510(k) process, "FDA's databases identified one-quarter as being for devices that were implantable; were life sustaining; or presented significant risk to the health, safety, or welfare of a patient."[5(p18)] The GAO also pointed out that these devices should have been subjected to the more stringent PMA process.

STUDY DESIGN AND MAIN OUTCOME MEASURE

Using data available on the FDA Web site (www.fda.gov), we analyzed how often the FDA issued high-risk recalls of medical devices cleared through the various FDA processes: the more rigorous PMA process, the 510(k) process, or exempt from FDA review. We started with the devices on FDA's List of Device Recalls,[7] which includes only devices about which the FDA concluded "there is a reasonable chance that they could cause serious health problems or death."[7(p1)] For each device on this high-risk recall list from 2005 through 2009, we used the FDA Web site link to product information to determine the process the FDA used to initially review or register the device.

RESULTS

From January 2005 through December 2009, the FDA included 115 names of recalled devices (involving millions of units) on their high-risk recall list. Of these 115 recalls, the FDA designated 113 as Class I recalls, which the FDA defines as the highest risk based on information provided to the FDA by health professionals, researchers, patients, or device companies. In fiscal year 2006, for example, the FDA received reports of 116 086 potential device-related injuries, 2830 potential device-related deaths, and more than 200 000 adverse event reports concerning medical devices.[8] The FDA uses these reports to help deter-

©2011 American Medical Association. All rights reserved.

Downloaded From: http://jamanetwork.com/ on 05/19/2013

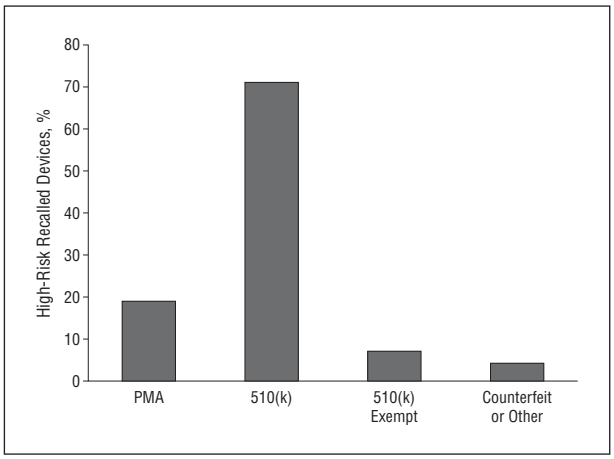

Figure 1. High-risk recalled devices classified by how the US Food and Drug Administration reviewed them from 2005 through 2009. PMA indicates premarket approval; 510(k), the less stringent premarket notification process.

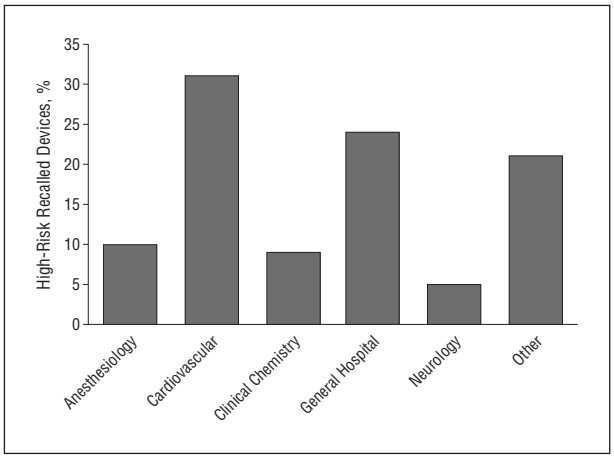

Figure 2. High-risk recalled devices categorized by medical specialty designated by the US Food and Drug Administration.

mine whether a device should be recalled because of a high risk to patients.

The PMA process was used to approve only 21 of the 113 devices listed as high-risk recalls that could cause serious health problems or death (19%).[7] Eighty were cleared through the 510(k) process (71%), and an additional 8 were completely exempt from FDA regulation and were merely registered with the FDA (7%). In addition, four were counterfeit devices or categorized as "other" (4%) and did not go through any of the 3 processes for approval, clearance, or registration (**Figure 1**).

Cardiovascular devices comprised the largest recall category, with 35 separate recalls accounting for 31% of devices on the FDA's high-risk recall list (**Figure 2**). Two-thirds of these recalled cardiovascular devices were cleared by the 510(k) process (66%; n=23), while 34% were approved through the PMA process (n=12). Despite the FDA law that requires almost all Class III devices to be approved through the more stringent PMA process, 13 of the 510(k) high-risk recalled devices were designated as Class III devices (12%). All of these recalled devices were used for treating cardiovascular disease. Most were automated external defibrillators

Table. High-Risk Recalls of Class III Devices Cleared Through 510(k)

Date Recalled	Device
July 31, 2009	LIFEPAK CR Plus AED (Physio-Control Inc, Redmond, Washington)
February 12, 2009	AED Plus (ZOLL Medical Corporation, Chelmsford, Massachusetts)
February 2, 2009	Intra-aortic balloons (30, 40, and 50 mL) (Teleflex Medical, Research Triangle Park, North Carolina)
December 15, 2008	AED 10 and MRL Jumpstart AED (Welch Allyn Inc, Skaneateles Falls, New York)
August 28, 2008	LIFEPAK CR Plus AED (Physio-Control Inc)
March 17, 2008	CentriMag Extracorporeal Blood Pumping System including CentriMag Primary Console (Levitronix LLC, Waltham, Massachusetts)
October 26, 2007	AED 10 (Welch Allyn Inc)
August 24, 2007	AED 20 (Welch Allyn Inc)
February 17, 2007	Lifeline AED and ReviveR AED (Defibtech LLC, Guilford, Connecticut)
June 15, 2006	AED 20 (Welch Allyn Inc)
April 28, 2005	AED 20 (Welch Allyn Inc)
February 14, 2005	Samaritan AEDs (various models) (HeartSine Technologies Inc (Newtown, Pennsylvania)
February 3, 2005	LIFEPAK 500 AED (certain models) (Medtronic, Redmond, Washington)

Abbreviations: AED, Automated external defibrillator; 510(k), the less stringent premarket notification process.

(AEDs) approved for resuscitation of patients in cardiac arrest (**Table**). Researchers have reported that more than 20% of the almost 1 million AEDs in circulation were recalled by the FDA, and hundreds of people died due to AED malfunctions.[9]

The second largest high-risk recall category (24 % of the total) was made up of 27 general hospital devices, including insulin pumps, intravenous infusion devices, and patient lifts. Seventy-four percent of these recalled devices were cleared through 510(k) review (n=20) and only 22 % were approved through the more rigorous PMA process (n=6).

The third largest high-risk recall category (10 % of the total) was anesthesiology devices, including mechanical ventilators. All of these devices were cleared by the 510(k) process (10 devices) or were exempt from review (1 device).

The fourth and fifth largest categories of high-risk recalls were clinical chemical analysis and neurologic devices, respectively. Nine percent of all recalls were clinical chemical analysis devices such as glucose meters and other diagnostic testing equipment (n=10). These devices were cleared by the 510(k) process (7 devices, 70%), were exempt from review (1 device, 10%), or were not approved or cleared at all because they were counterfeit or in the *other* category (2 devices, 20%). Five percent of the high-risk recalls were neurologic devices (n=6), which included shunts and devices for the face, jaw, and cranium. One device was counterfeit and therefore was neither approved nor cleared; the remaining 5 of these recalled devices were cleared by the 510(k) process (83%). None was approved through the PMA process.

Only 3 devices of the high-risk recalls were in the ophthalmic category (3%). However, this category had the highest number of units recalled—57 254 133—with almost all units from the recall being 1 contact lens solu-

©2011 American Medical Association. All rights reserved.

Downloaded From: http://jamanetwork.com/ on 05/19/2013

tion (COMPLETE MoisturePLUS multi-purpose contact lens solution; Advanced Medical Optics Inc, Santa Ana, California).[10] This lens solution was recalled when some users contracted parasitic eye infections that resulted in blindness or required a corneal transplant.

COMMENT

The present analysis demonstrates that most of the medical devices recalled by the FDA owing to serious risks during the past 5 years were approved through the 510(k) regulatory process or were completely exempt from regulatory review (78%). As such, these devices did not undergo clinical testing or premarket inspections, nor were postmarket studies required to determine safety and efficacy. While even the more rigorous PMA criteria for device approval are often scientifically inadequate to ensure patient safety,[11] PMA standards are clearly superior to 510(k) standards. Of the recalled devices cleared for market through the 510(k) process, 12% were marketed for risky or life-sustaining Class III indications, which are required by law to undergo a full PMA regulatory review. The devices recalled owing to high risks spanned a broad range of clinical applications, but cardiovascular devices represented the most common category (31%) (Figure 2). These findings demonstrate systematic problems in the implementation of existing medical device regulations that have exposed patients to serious harm.

The FDA's implementation of the 510(k) process has received considerable criticism from public health advocates and from other federal agencies in reports, medical journal articles, and testimony before Congress.[5,9,12,13] Several months after the GAO's critical report in January 2009, the FDA requested that the Institute of Medicine conduct an independent outside review (currently under way) of the 510(k) process.[14] Subsequently, in August 2010, the FDA released an internal report that suggested numerous changes intended to strengthen and clarify the 510(k) process.[15]

In that August 2010 report, the FDA 510(k) Working Group acknowledged that "in recent years, concerns have been raised within and outside of FDA about whether the current 510(k) program optimally achieves [the] goals"[15(p3)] of ensuring that devices are safe and effective and fostering innovation in the medical device industry. The FDA report suggested that clinical trials should be required in more 510(k) reviews and that safety would be enhanced if the FDA had expanded authority to require premarket inspections and postmarket studies as a condition of clearance. AdvaMed,[16,17] the largest association representing medical device manufacturers, opposes these changes.

One reason that the FDA has relied heavily on the 510(k) process is because it is less expensive and enables the relatively small Center for Devices and Radiological Health (CDRH) to review thousands of devices each year. For example, in 2005, the average cost for the FDA to review a 510(k) submission was estimated at $18 200, while a PMA submission cost the agency $870 000 to review.[5] The Congress has not appropriated sufficient funds to the CDRH to use the more expensive PMA process for most devices, and this large cost differential creates an incentive for CDRH to rely heavily on the 510(k) process. The FDA is partially supported by industry user fees, but the FDA charges much smaller user fees to review medical devices than it charges to review prescription drugs, even for the largest companies. In 2010, the FDA charged a standard fee of $4007 for a 510(k) submission (and only half that amount for small companies) and $217 787 for an original PMA (one-quarter that amount for small companies)[18] compared with $702 750 to $1 405 500 for prescription drug applications.[19] The PMA user fees provide less than one-fourth of the $870 000 average cost of the review in terms of FDA staff and resources, creating a disincentive for the FDA to select the PMA process. As part of the reauthorization of the FDA law that requires user fees, the FDA is currently holding meetings with pharmaceutical and device companies to consider changes in user fees for drugs and devices.[20,21]

In addition to not requiring clinical trials, there are 3 other aspects of the 510(k) process that are much less stringent than the PMA process: (1) under 510(k), the FDA does not generally require premarket inspections of how the devices were manufactured[5]; (2) the FDA does not require postmarket studies as a condition of clearance[22]; and (3) the FDA has much more limited authority to rescind or withdraw clearance of a 510(k) device that is found to be unsafe or ineffective.[23]

The US courts have recognized the shortcomings of the 510(k) process. In *Lohr vs Medtronic Inc*, the US Court of Appeals for the 11th Circuit in 1995 stated "The 510(k) process is focused on *equivalence*, not safety, and the question of whether a device has been deemed safe and effective cannot be resolved by looking at the 510(k) process [emphasis in the original]."[1(p1348)] In 1996, the Supreme Court affirmed the 11th Circuit conclusions that "[s]ince the § 510(k) process is focused on *equivalence,* not safety, substantial equivalence determinations provide little protection to the public [emphasis in the original]."[24(p493)]

In an analysis funded by AdvaMed, a Batelle report recently concluded that the 510(k) process was adequate because the number of high-risk recalls represents a small proportion of devices cleared through the 510(k) process.[25] However, that analysis did not take into account the public health implications for patients and the US medical system. As noted herein, FDA data and previous studies in medical journals indicate that high-risk recalled 510(k) devices were used by tens of millions of patients, exposing them to potential harm and adding substantial costs to medical care. On a policy level, the present analysis and the 2009 GAO analysis[5] indicate that the FDA is not fully implementing the law that requires high-risk medical devices to be approved through the PMA process and frequently uses the 510(k) process instead.

An important question is whether the risks resulting from subsequently recalled devices could have been prevented if the 510(k) or exempt devices had been subject to a more rigorous review process. Clinical trials and other more rigorous premarket data collection required in the PMA process but not the 510(k) process could uncover design flaws or manufacturing flaws before a device is sold. Premarket inspections, which are required for PMA devices but rarely used as part of the current 510(k) review process, could also uncover manufacturing flaws that

©2011 American Medical Association. All rights reserved.

Downloaded From: http://jamanetwork.com/ on 05/19/2013

result in products that are less safe or less effective for patients and consumers. Requiring postmarket studies as a condition of approval, which is an option for PMA approval but not usually for 510(k) clearance, could help determine risks sooner than the current adverse-event reporting system.

CONCLUSIONS

Medical devices cleared through the less rigorous 510(k) pathway comprise more than two-thirds of the products that are recalled by the FDA because they could seriously harm patients or result in death. When devices that were intentionally exempt from any FDA review were added to the 510(k) devices, they comprise more than 3 out of 4 of the high-risk recalls during the last 5 years. Thus, the standards used to determine whether a medical device is a high-risk or life-sustaining product prior to approval are clearly very different from the standards used to recall a medical device as life threatening. Our findings reveal critical flaws in the current FDA device review system and its implementation that will require either congressional action or major changes in regulatory policy.

The results of the present analysis indicate that the number of high-risk recalls of medical devices and the number of patients affected by these recalls would be substantially decreased if the following changes were made in the FDA process:

1. The FDA fully implements current law that subjects "life-saving and life sustaining" (Class III) devices to the PMA process;
2. The FDA's definition of a high-risk device takes into account the potential risks if the device fails;
3. The FDA expands the use of their authority to inspect the manufacturing of 510(k) devices just as they do for devices approved through the PMA process; and
4. The FDA strengthens their authority to use special controls for 510(k) devices as they do for PMA devices, such as postmarket surveillance, performance standards, and product-specific and general guidance documents.

Accepted for Publication: December 9, 2010.
Published Online: February 14, 2011. doi:10.1001/archinternmed.2011.30
Correspondence: Diana M. Zuckerman, PhD, National Research Center for Women & Families, 1001 Connecticut Ave NW, Ste 1100, Washington, DC 20036 (dz@center4research.org).
Author Contributions: *Study concept and design:* Zuckerman and Brown. *Acquisition of data:* Brown. *Analysis and interpretation of data:* Zuckerman, Brown, and Nissen. *Drafting of the manuscript:* Zuckerman and Brown. *Critical revision of the manuscript for important intellectual content:* Zuckerman and Nissen. *Statistical analysis:* Zuckerman and Nissen. *Administrative, technical, and material support:* Brown and Nissen. *Study supervision:* Zuckerman and Brown.
Financial Disclosure: Dr Zuckerman owns stock in Johnson & Johnson. Dr Nissen consults for many pharmaceutical companies but requires them to donate all honoraria or consulting fees directly to charity so that he receives neither income nor a tax deduction for his services. The Cleveland Clinic Center for Clinical Research has received funding to perform clinical trials from Pfizer, Astra Zeneca, Novartis, Novo Nordisk, Roche, Daiichi-Sankyo, Karo Bio, Takeda, Sanofi-Aventis, Resverlogix, and Eli Lilly. Dr Nissen is involved in these clinical trials, but he receives no personal remuneration for his participation.
Funding/Support: This study was funded by individual donations to the National Research Center for Women & Families, which does not accept contributions from medical device companies.
Additional Contributions: Research assistants Sharon Cannistra, BA, Heidi Mallis, MPH, Padma Ravichandran, BS, and Meredith L. Van Tine, JD, provided valuable help with the data collection and analysis.

REFERENCES

1. Lohr v Medtronic Inc, 56 F3d 1335 (11th Cir 1995). http://scholar.google.com/scholar_case?case=9155174046926497575&q=Lohr+v.+Medtronic,+Inc.+&hl=en&as_sdt=2,9. Accessed January 13, 2011.
2. US Food and Drug Administration. Medical devices premarket approval (PMA). http://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/HowtoMarketYourDevice/PremarketSubmissions/PremarketApprovalPMA/default.htm. Accessed November 9, 2010.
3. Public health effectiveness of the FDA 510(k) clearance process: balancing patient safety and innovation: workshop report (2010) http://www.nap.edu/openbook.php?record_id=12960&page=9. Accessed November 30, 2010.
4. US Food and Drug Administration. interactive review for medical device submissions: 510(k)s, original PMAs, PMA supplements, original BLAs, and BLA supplements. http://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/GuidanceDocuments/ucm085994.htm. Accessed January 13, 2011.
5. US Government Accountability Office. FDA should take steps to ensure that high-risk device types are approved through the most stringent premarket review process: GAO-09-190: January 2009. http://gao.gov/new.items/d09190.pdf. Accessed November 9, 2010.
6. US Food and Drug Administration. Device classification. http://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/Overview/ClassifyYourDevice/default.htm. Accessed July 24, 2009.
7. US Food and Drug Administration. Medical devices: list of device recalls. http://www.fda.gov/MedicalDevices/Safety/RecallsCorrectionsRemovals/ListofRecalls/default.htm. Accessed August 17, 2010.
8. US Food and Drug Administration, Center for Devices and Radiological Health. CDRH FY 2006 highlights. www.fda.gov/downloads/AboutFDA/CentersOffices/CDRH/CDRHReports/ucm129258.pdf. Accessed August 21, 2009.
9. Maisel WH. Medical devices: are current regulations doing enough for patients? testimony before the Subcommittee on Health, Committee on Energy and Commerce, House of Representatives: June 2009. http://energycommerce.house.gov/index.php?option=com_content&view=article&id=1677. Accessed August 31, 2009.
10. US Food and Drug Administration. Medical & radiation emitting device recalls. http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfRES/res.cfm?id=52779. Accessed March 2, 2010.
11. Dhruva SS, Bero LA, Redberg RF. Strength of study evidence examined by the FDA in premarket approval of cardiovascular devices. *JAMA.* 2009;302(24):2679-2685.
12. Zuckerman D. Testimony on reauthorization of the Medical Device User Fee and Modernization Act before the Subcommittee on Health, Committee on Energy and Commerce, House of Representatives: May 2007. http://archives.energycommerce.house.gov/cmte_mtgs/110-he-hrg.051607.Zuckerman-Testimony.pdf. Accessed November 9, 2010.
13. Redberg RF. Medical devices and the FDA approval process: balancing safety and innovation; comment on "prevalence of fracture and fragment embolization of bard retrievable vena cava filters and clinical implications including cardiac perforation and tamponade." *Arch Intern Med.* 2010;170(20):1831-1833.
14. US Food and Drug Administration. Public health effectiveness of the FDA 510(k)

©2011 American Medical Association. All rights reserved.

Downloaded From: http://jamanetwork.com/ on 05/19/2013

clearance process: balancing patient safety and innovation: workshop report, October 14, 2010. http://www.books.nap.edu/openbook.php?record_id=12960&page=1. Accessed January 13, 2011.
15. US Food and Drug Administration. CDRH preliminary internal evaluations—volume I: 510(k) working group, preliminary report and recommendations. August 2010. http://www.fda.gov/downloads/AboutFDA/CentersOffices/CDRH/CDRHReports/UCM220784.pdf. Accessed August 17, 2010.
16. AdvaMed. AdvaMed statement on FDA public meeting (press release). October 2010. http://www.advamed.org/MemberPortal/About/NewsRoom/NewsReleases/PR-FDA510K-10810.htr. Accessed November 9, 2010.
17. Medical Device Industry Applauds Lawmaker Concern Over Review Process. *CQ Healthbeat News*. October 13, 2010.
18. Federal Register. Medical device user fee rates for fiscal year 2010: Docket No. FDA-2009-N-0338: August 2009. http://edocket.access.gpo.gov/2009/E9-18456.htm. Accessed June 21, 2010.
19. Federal Register. Prescription drug user fee rates for fiscal year 2010: Docket No. FDA-2009-N-0339: August 2009. http://edocket.access.gpo.gov/2009/E9-18457.htm. Accessed June 18, 2010.
20. Federal Register. Prescription Drug User Fee Act; public meeting: docket No. FDA-2010-N00128: March 2010. http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2010_register&docid=fr16mr10-68.pdf. Accessed August 18, 2010.
21. Federal Register. Medical Device User Fee Act; public meeting: Docket No. FDA-2010-N00389: August 2010. http://edocket.access.gpo.gov/2010/2010-19843.htm. Accessed August 13, 2010.
22. Rosecrans HS. FDA's 510(k) workshop: issues related to postmarket surveillance and new information about marketed devices: February 2010. http://www.fda.gov/downloads/MedicalDevices/NewsEvents/WorkshopsConferences/UCM201345.pdf. Accessed March 2, 2010.
23. Tillman D-B. Understanding the premarket notification 510(k) process: FDA's 510(k) working group presentation to the Institute of Medicine: March 2010. http://www.iom.edu/~/media/Files/Activity%20Files/PublicHealth/510kProcess/2010-MAR-01/Tillman-The%20510k%20Working%20Group.ashx. Accessed November 9, 2010.
24. Medtronic Inc v Lohr, 518 US 470 (1996). http://scholar.google.com/scholar_case?case=9764091134585266905&q=Medtronic,+Inc.+v+Lohr+et+vir&hl=en&as_sdt=2,9. Accessed January 13, 2011.
25. McCarty M. Batelle says 510(k) recalls since '98 are at less than 1%. http://www.medicaldevicedaily.com/servlet/com.accumedia.web.Dispatcher?next=bioWorldHeadlines_article&forceid=72862. Accessed November 9, 2010.

INVITED COMMENTARY

ONLINE FIRST

Medical Device Recalls

Get It Right the First Time

Consumers are justifiably upset when their cars, toasters, and baby food bottles are recalled. Recalls make us all question the safety of the products we take for granted. But what about the products permanently implanted inside our bodies? Surely they have been sufficiently tested to ensure that no one will need to bring their thorax to the shop for removal and replacement. It is sad and troubling to learn that we cannot count on this assurance for some medical devices.

Medical devices are divided into 3 classes by the FDA, according to their level of risk to patients.[1] Class I devices pose a low risk, present minimal potential harm to patients (items such as stethoscopes and bandages), and are subject to minimal regulation. Class II devices pose a moderate risk, include such items as hearing aids and wheelchairs, and may be cleared through the 510(k) premarket notification process, whereby they can be marketed if they are substantially equivalent to a predicate device. Importantly, clinical trials are not necessary for these 2 device classes.

Class III devices, such as stents and implantable cardioverter-defibrillators, pose a potential high risk and are defined as those devices that "support or sustain human life, are of substantial importance in preventing impairment of human health, or which present a potential, unreasonable risk of illness or injury."[1] The FDA states that "Premarket approval (PMA) is the *required* process of scientific review to ensure the safety and effectiveness"[1] of these devices

A 2009 GAO report of all FDA reviews of high-risk devices in fiscal years 2003 through 2007[2] found that more high-risk devices get cleared via the 510(k) than through the original PMA process. Simply put, this means that more often than not, the highest-risk devices are being approved, marketed, and used in patients without any clinical trial data. Therefore, although the FDA committed some time ago to require that high-risk devices be either evaluated through PMA or reclassified to a lower risk class, neither has yet occurred. Indeed, it has been over 20 years since Congress passed the Safe Medical Devices Act, envisioning that this would happen.[2] However, currently, only 1% of all devices go through PMA.

Zuckerman and colleagues demonstrate the dangers to patient safety posed by these innumerable device misclassifications. They review the approval pathway for all high-risk recalls of medical devices from 2005 through 2009. Although high-risk device recalls are defined as those that could cause serious health problems or death, more than three-fourths of these potentially lethal devices were not approved by PMA. Instead, most were cleared through the weaker 510(k) process, which does not require any clinical data on safety or effectiveness before or after approval. A few were even considered exempt from review. Ultimately, this means that devices not considered during the approval process to pose a potentially high risk might still be subject to a high-risk recall. This paradox presents a critical safety concern.

Cardiovascular devices were the most common category for high-risk recalls. For example, hundreds of deaths have been attributed to AED malfunctions, while it remains unclear how many lives these devices may have saved. Another worrisome example is the Sprint Fidelis (Medtronic, Minneapolis, Minnesota), an implantable cardioverter-defibrillator approved by the FDA in 2004 without any premarket clinical testing.[3] It was subsequently implanted in 268 000 patients over 3 years before being voluntarily withdrawn by the manufacturer owing to the possibility of lead fracture, which led to inappropriate

©2011 American Medical Association. All rights reserved.

Downloaded From: http://jamanetwork.com/ on 05/19/2013