Patient-centered Medical Devices for Patients with Multimorbidity

Simeon T. Abiola, ALB
Translational Biomedical Science Ph.D. Candidate | AGRT Competition
University of Rochester School of Medicine and Dentistry
February 13, 2019

Strategic Plan for Regulatory Science - Section 4

1. **Implement innovative strategies, to facilitate partnerships that create new device development.**
2. **Expedited pathways for development, assessment, and approval of important devices.**
3. **Encourages early conversations with developers to make sure their ideas are translated into technologies that both help patients and are proven safe and effective.**

Strategic Plan for Regulatory Science - Section 5

FDA receives a vast amount of information from a variety of sources, including product submissions, adverse event reports, de-identified patient data from health care providers, and results from surveys and basic scientific research. Successful integration and analysis of data from these disparate sources would provide knowledge and insight not possible from any one source alone.

1. **Integrate and analysis data from disparate sources to provide knowledge and insight not possible from any one source alone.**

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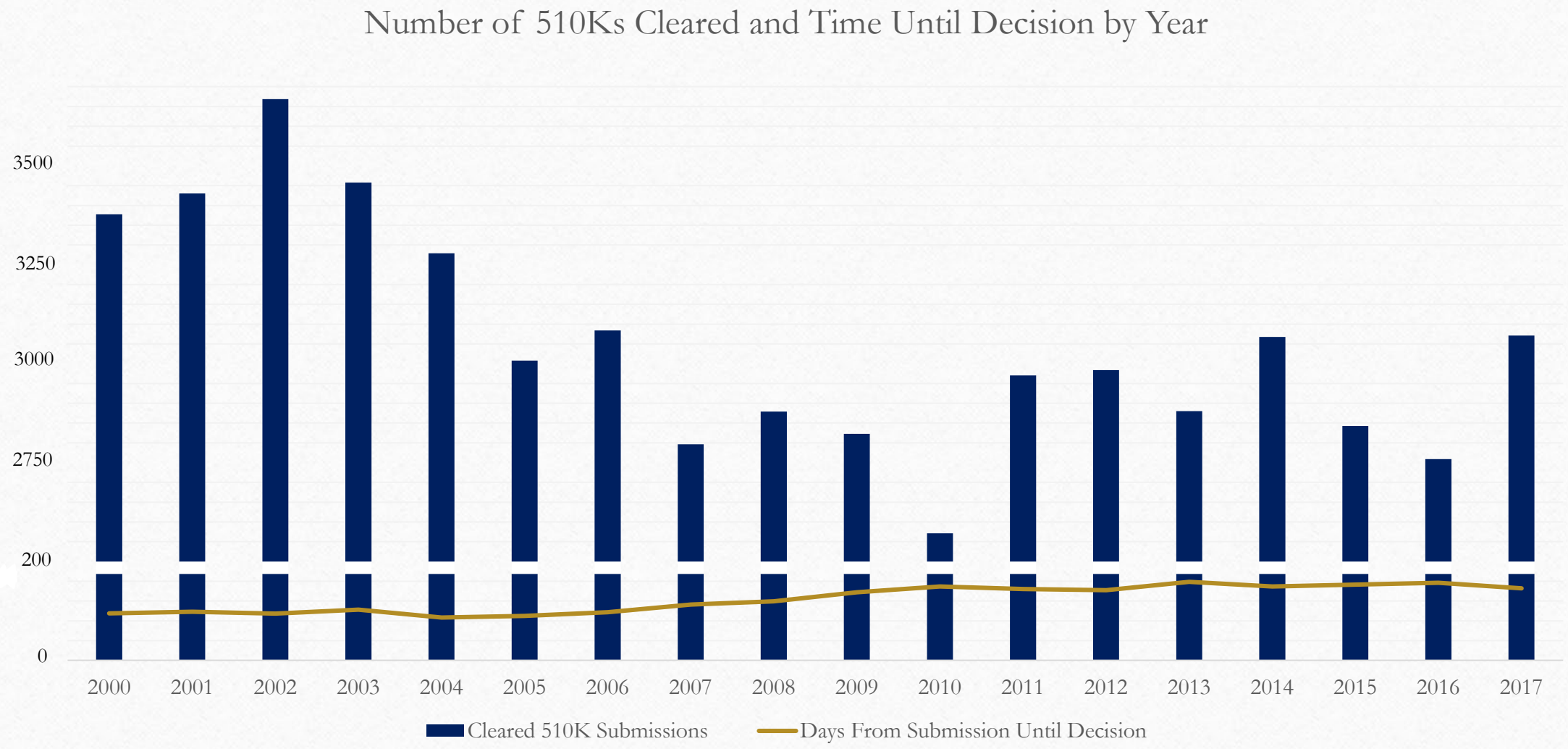
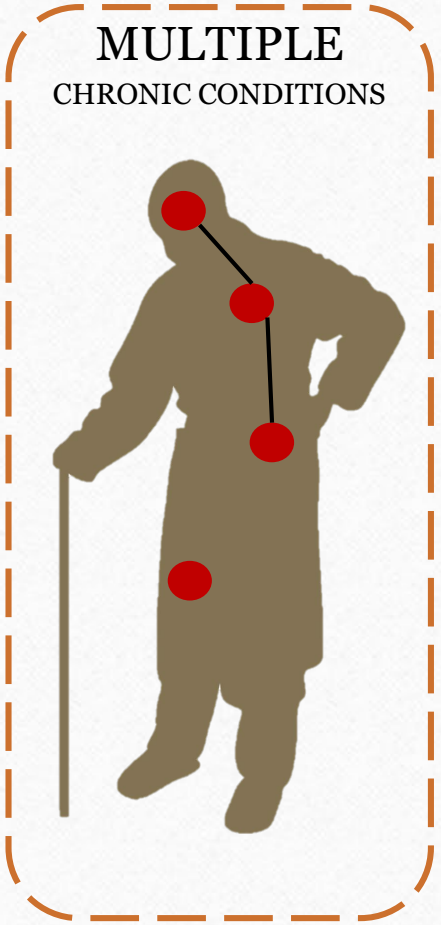
Ensuring the FDA's Readiness – Section 4



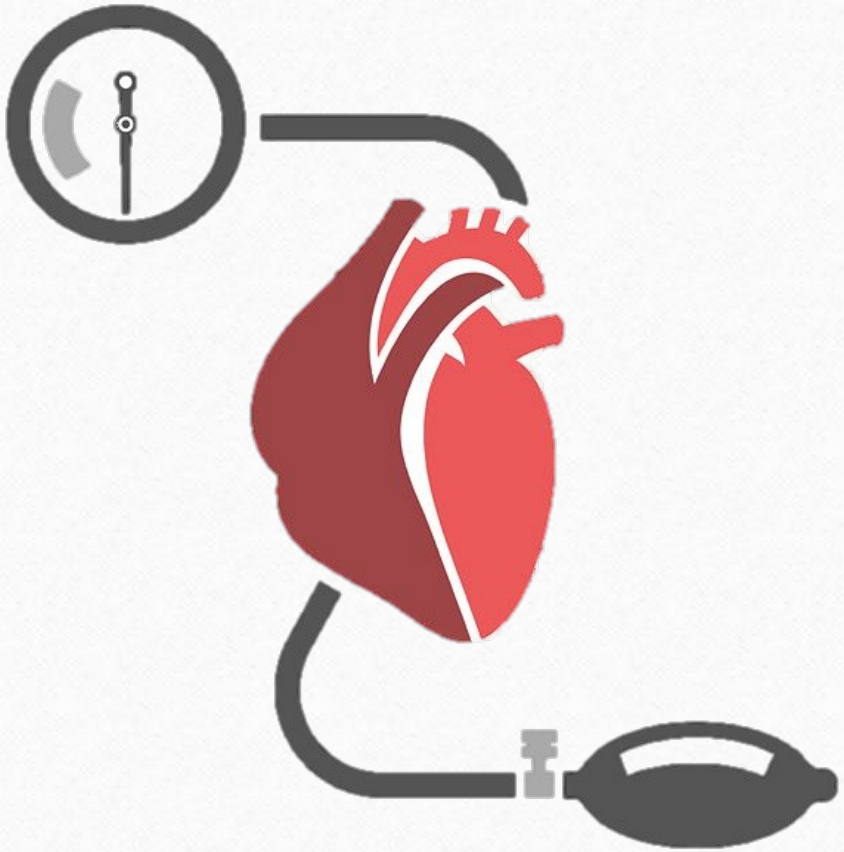
Improve Health Outcomes – Section 5

- 100 million Americans (and rising) have multiple chronic conditions.
- Multiple chronic conditions (or multimorbidity) is:
  - The presence of two or more chronic condition,
  - Lasting 12 months or longer,
  - Which place limitations on self-care,
  - and require ongoing medical management.
- "Although **patients with multiple health issues** use eHealth technology to support self-care for specific conditions, they also **desire tools that transcend disease boundaries.**"



Prior to our research…

Which medical devices are appropriate for monitoring which chronic conditions?



Filling the Gap: 510Ks & Clinical Practice Guidelines

U.S. FOOD & DRUG ADMINISTRATION

April 25, 2018

Spineology Inc.
Jacqueline Hauge
Regulatory Affairs Manager
7800 3rd Street N., Suite 600
St. Paul, Minnesota 55128

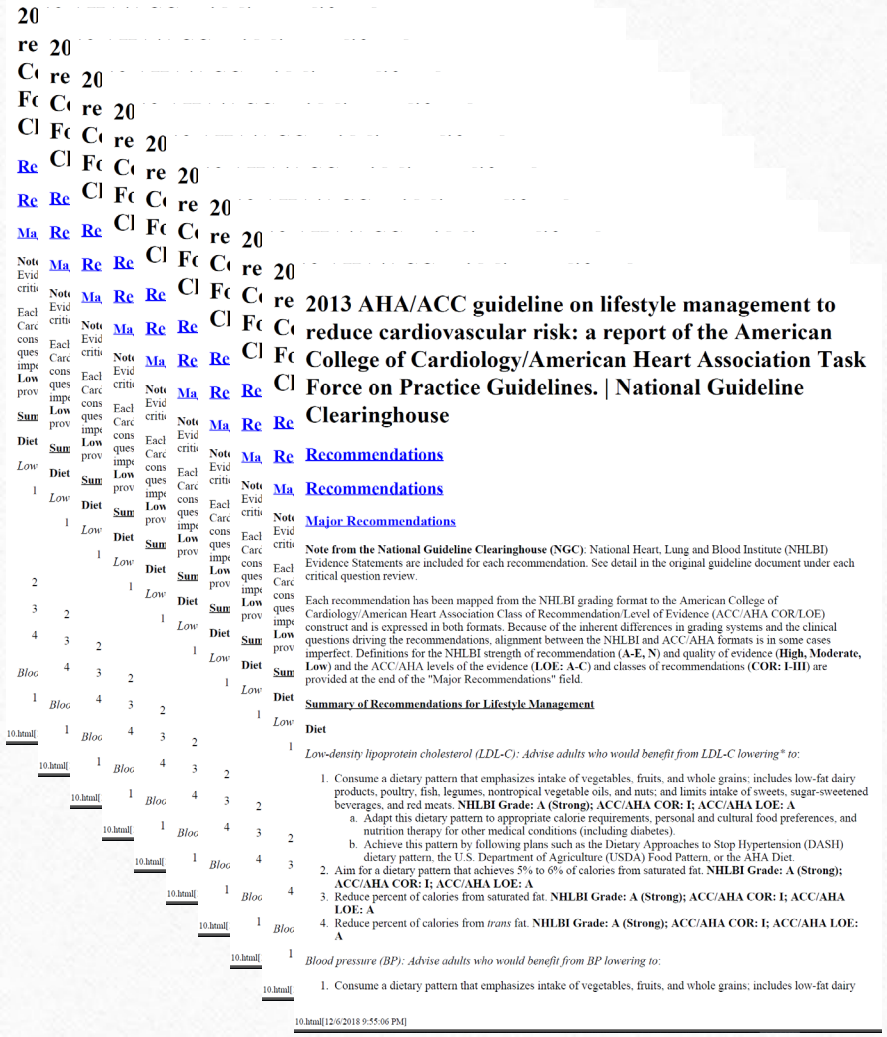
Re: K180002
Trade/Device Name: Rampart™ One Lumbar Interbody Fusion Device
Regulation Number: 21 CFR 888.3080
Regulation Name: Intervertebral Body Fusion Device
Regulatory Class: Class II
Product Code: OVD
Dated: March 23, 2018
Received: March 26, 2018

Dear Ms. Hauge:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820);



2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. | National Guideline Clearinghouse

Recommendations

Recommendations

Major Recommendations

Note from the National Guideline Clearinghouse (NGC): National Heart, Lung and Blood Institute (NHLBI) Evidence Statements are included for each recommendation. See detail in the original guideline document under each critical question review.

Each recommendation has been mapped from the NHLBI grading format to the American College of Cardiology/American Heart Association Class of Recommendation/Level of Evidence (ACC/AHA COR/LOE) construct and is expressed in both formats. Because of the inherent differences in grading systems and the clinical questions driving the recommendations, alignment between the NHLBI and ACC/AHA formats is in some cases imperfect. Definitions for the NHLBI strength of recommendation (**A-E, N**) and quality of evidence (**High, Moderate, Low**) and the ACC/AHA levels of the evidence (**LOE: A-C**) and classes of recommendations (**COR: I-III**) are provided at the end of the "Major Recommendations" field.

Summary of Recommendations for Lifestyle Management

Diet

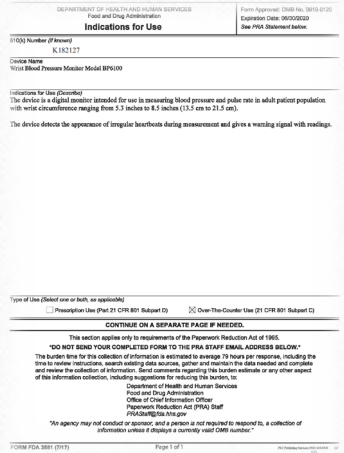
Low-density lipoprotein cholesterol (LDL-C): Advise adults who would benefit from LDL-C lowering to:*

1. Consume a dietary pattern that emphasizes intake of vegetables, fruits, and whole grains; includes low-fat dairy products, poultry, fish, legumes, nontropical vegetable oils, and nuts; and limits intake of sweets, sugar-sweetened beverages, and red meats. **NHLBI Grade: A (Strong); ACC/AHA COR: I; ACC/AHA LOE: A**
   a. Adapt this dietary pattern to appropriate calorie requirements, personal and cultural food preferences, and nutrition therapy for other medical conditions (including diabetes).
   b. Achieve this pattern by following plans such as the Dietary Approaches to Stop Hypertension (DASH) dietary pattern, the U.S. Department of Agriculture (USDA) Food Pattern, or the AHA Diet.
2. Aim for a dietary pattern that achieves 5% to 6% of calories from saturated fat. **NHLBI Grade: A (Strong); ACC/AHA COR: I; ACC/AHA LOE: A**
3. Reduce percent of calories from saturated fat. **NHLBI Grade: A (Strong); ACC/AHA COR: I; ACC/AHA LOE: A**
4. Reduce percent of calories from *trans* fat. **NHLBI Grade: A (Strong); ACC/AHA COR: I; ACC/AHA LOE: A**

Blood pressure (BP): Advise adults who would benefit from BP lowering to:

1. Consume a dietary pattern that emphasizes intake of vegetables, fruits, and whole grains; includes low-fat dairy

Filling the Gap: 510Ks & Clinical Practice Guidelines



DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

Form Approved: OMB No. 0910-0120
Expiration Date: 06/30/2020
See PRA Statement below.

510(k) Number (if known)
K182127

Device Name
Wrist Blood Pressure Monitor Model BP6100

Indications for Use (Describe)
The device is a digital monitor intended for use in measuring blood pressure and pulse rate in adult patient population with wrist circumference ranging from 5.3 inches to 8.5 inches (13.5 cm to 21.5 cm).

The device detects the appearance of irregular heartbeats during measurement and gives a warning signal with readings.

Type of Use (Select one or both, as applicable)
☐ Prescription Use (Part 21 CFR 801 Subpart D) ☒ Over-The-Counter Use (21 CFR 801 Subpart C)

CONTINUE ON A SEPARATE PAGE IF NEEDED.

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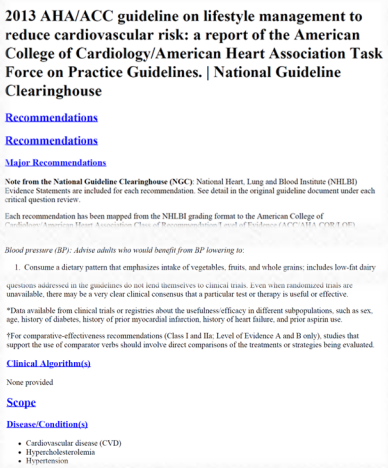

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*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as sex, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use.

†For comparative-effectiveness recommendations (Class I and IIa; Level of Evidence A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

- Cardiovascular disease (CVD)
- Hypercholesterolemia
- Hypertension

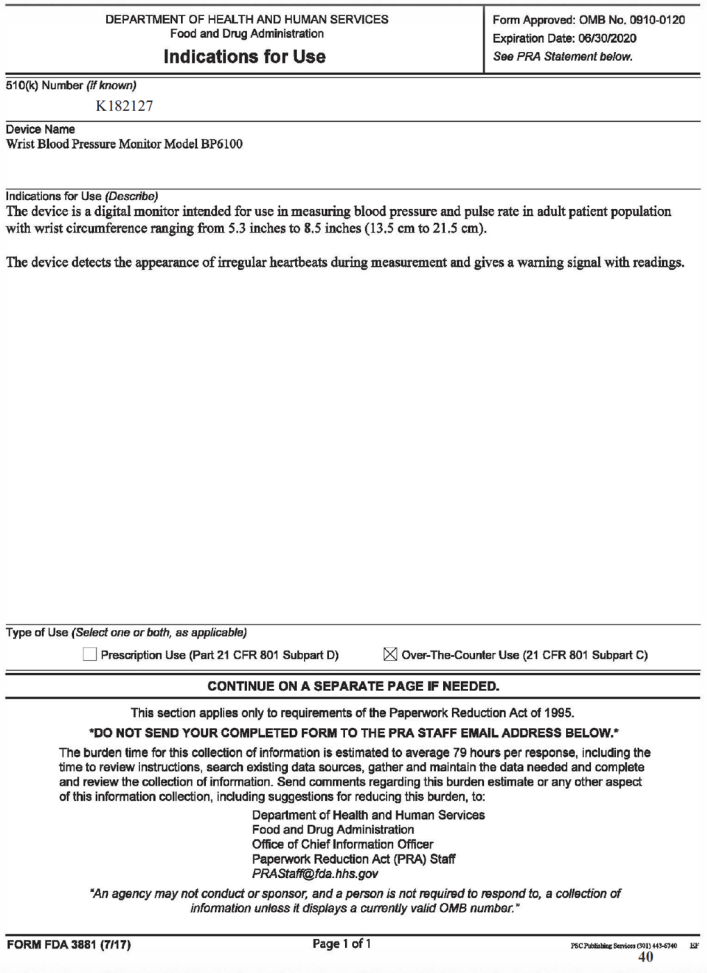
Premarket Notifications (510Ks)

- Required for every medical device prior to sale in the United States
- Described within is the intended use, or uses, for the medical device

Clinical Practice Guidelines (CPGs)

- CPGs are ubiquitous to clinical practice
- CPGs provide evidence-based statements to assist practitioners in healthcare decision making

Filling the Gap: Applying Natural Language Processing



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Optical Character Recognition

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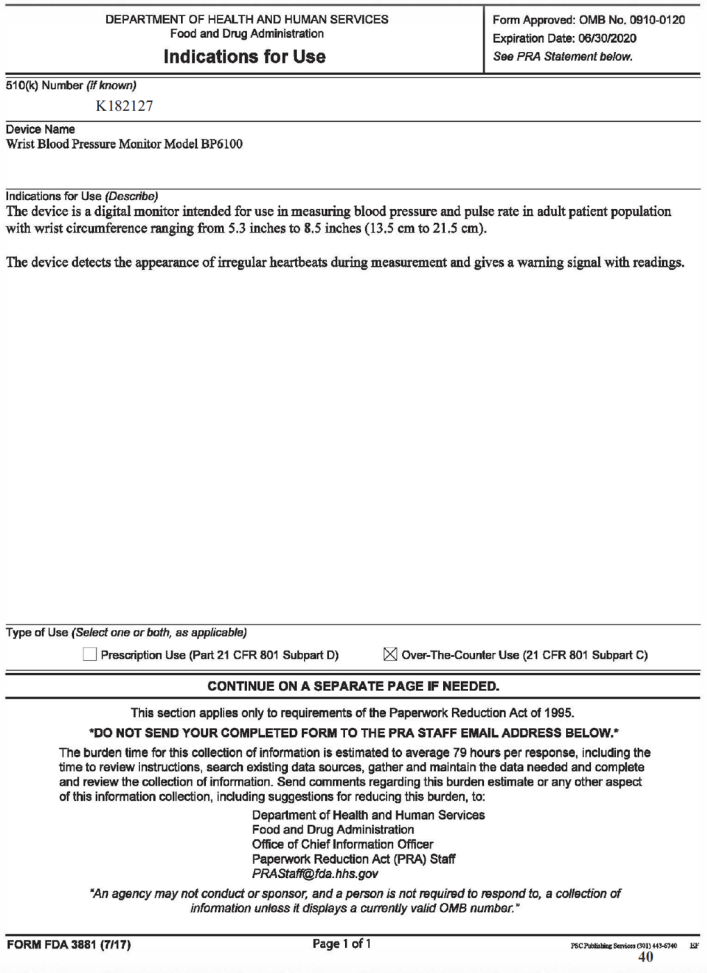
MetaMapLite

The device is a digital **monitor** intended for use in measuring **blood pressure** and **pulse rate** in adult patient population
with wrist circumference ranging from 5.3 inches to 8.5 inches (13.5 cm to 21.5 cm).

The device detects the **appearance** of irregular heartbeats during measurement and gives a warning signal with readings.

Filling the Gap: Applying Natural Language Processing



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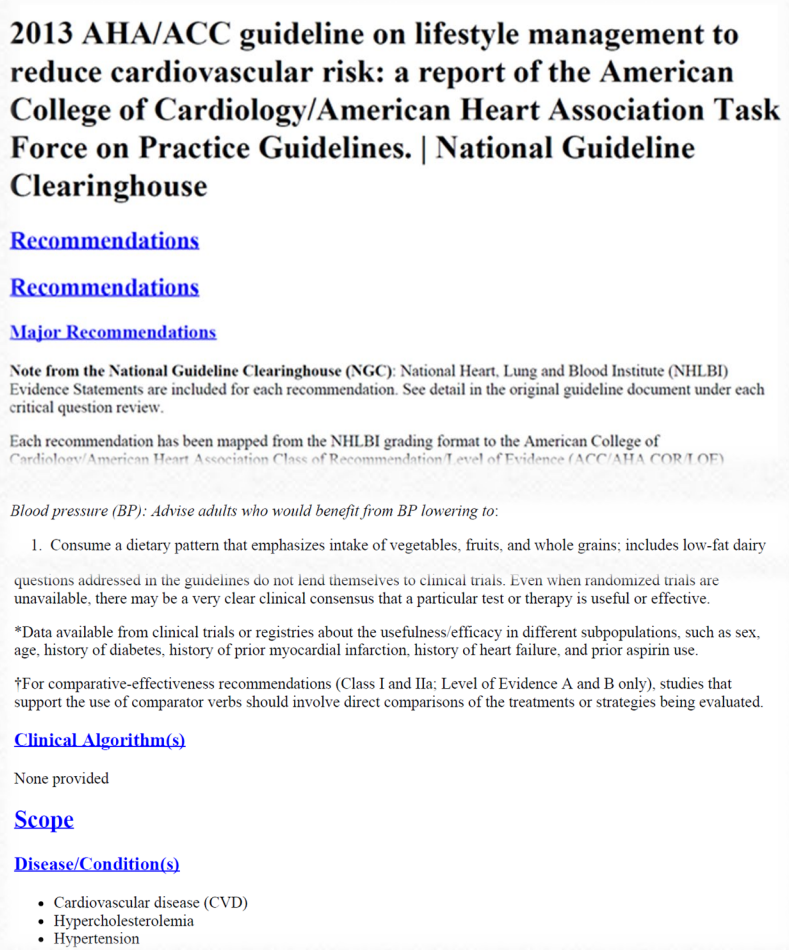
Medical Text Indexer (MTI)

K182127	K180240	K170605	MTI
~~Monitor~~	~~Monitor~~		
Blood Pressure	Diastolic Blood Pressure	Blood Pressure	Blood Pressure
Pulse Rate	Heart Rate	Pulse Rate	Heart Rate
Appearance			Body Image

MetaMapLite *

*MetaMapLite was run a second time before organizing the output into a table.

Filling the Gap: Applying Natural Language Processing



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Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

- Cardiovascular disease (CVD)
- Hypercholesterolemia
- Hypertension

Assigning ICD-10 Codes

Disease/Condition	ICD-10 Code
Cardiovascular Disease (CVD)	I51.9
Hypercholesterolemia	E78.0

MetaMapLite

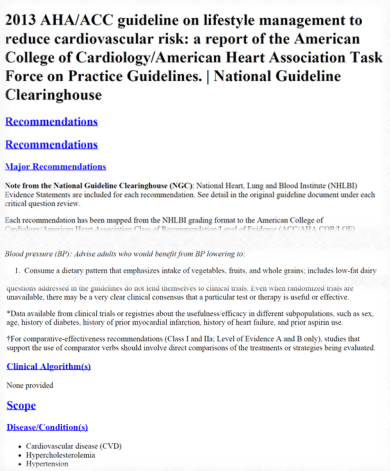
Blood pressure (BP): Advise adults who would benefit from BP lowering to...

Medical Text Indexer (MTI)

Disease/Condition	ICD-10 Code	Attribute
Cardiovascular Disease (CVD)	I51.9	Blood Pressure
Hypercholesterolemia	E78.0	Blood Pressure

Filling the Gap: Transitive Property on Inequality

Clinical Practice Guidelines



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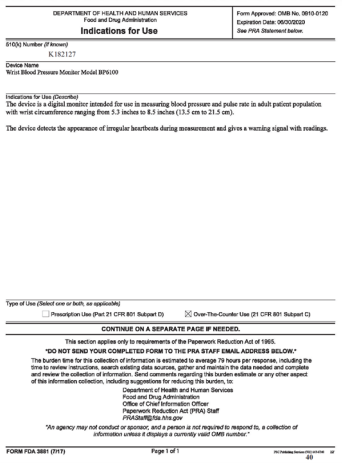
ICD-10 Code	Attribute
I51.9	Blood Pressure
E78.0	Blood Pressure
I10*	Blood Pressure

A = B

Premarket Notifications (510Ks)



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Attribute	Product Code
Blood Pressure	DXN
Blood Pressure	DXN
Blood Pressure	DXN

B = C

A proprietary dataset*

ICD-10 Code	Product Code
I51.9	DXN
E78.0	DXN
I10	DXN

*Preliminary Results

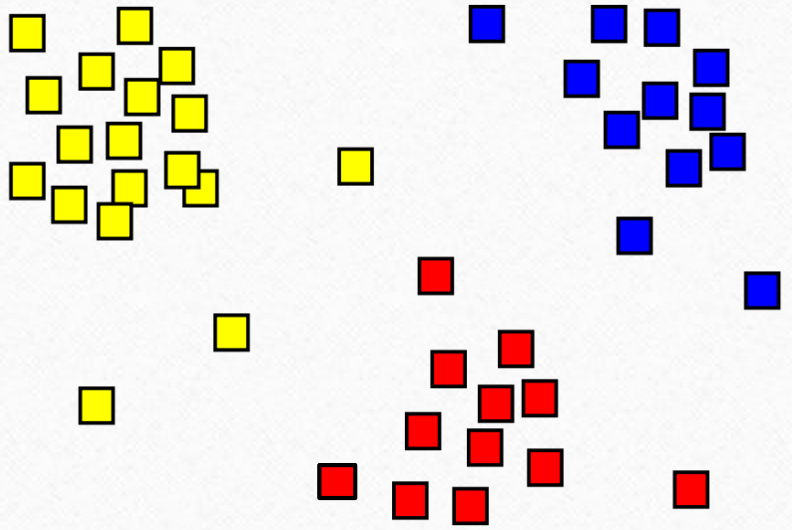
A = C

Deriving Insights: Once the Gap was Filled

- Medical Expenditure Panel Survey (MEPS)
  - Collects nationally representative data on demographic characteristics, health conditions **(ICD-10 codes)**, health status, use of medical care services, charges and payments, access to care
  - Linking our dataset with MEPS will help elucidate the diagnostic capabilities a device should include to monitor patterns of multimorbidity.
- Nationwide Emergency Department Sample (NEDS)
  - Is the largest all-payer emergency department (ED) database in the United States containing diagnosis and procedure codes reported using the **ICD-10-CM**/PCS coding system.
  - Linking our dataset with NEDS will provide insights into the diagnostic capabilities a device should include to augment existing telemedicine services.

Applying Insights: Once the Gap was Filled

- Determining Equivalence Using Machine Learning
  - Multi-label K-nearest neighbor
  - “In multi-label learning, the training set is composed of instances each associated with a set of labels, and the task is to predict the label sets of unseen instances through analyzing training instances with known label sets.”



In Summary

- **We developed a proprietary dataset**, using 50,000+ premarket submission, 1,409 clinical practice guidelines, natural language processing, and the Transitive Property of Inequality.
- **We showed how to integrated and analyze our dataset with two nationally representative datasets** to give medical device developers ideas for technologies with the potential to **aMELIORAte patient's burden of multimorbidity and reduce Emergency Department Utilization.**
- We showed how this research may be used to **expedited the pathway for the development** and clearance of important devices.
- Wait there's more…

Please join me on March 20th 12 PM in HWH!

School of Nursing Clinical & Research Grand Rounds

Simeon Abiola, ALB a Translational Biomedical Science PhD Candidate working with **Dr. Kimberly Arcoleo, PhD, MPH,** will present on "*Patient-Centered Medical Devices for Patients with Multimorbidity.*"

A lunch of pizza and vegetable tray will be provided starting at 12 p.m., followed by the presentation from 12:10-12:40, leaving time for questions and discussion.

The School of Nursing Clinical & Research Grand Rounds seeks to engage faculty, staff, students, and other members of the healthcare community by presenting topics related to the research process as well as current research topics at the School of Nursing.

Wednesday, March 20 at 12:00pm to 1:00pm

Helen Wood Hall, SON Auditorium 1w304
255 Crittenden Boulevard, Rochester NY 14642

thank you!