I. Course Description
   A. The Centers of Medicare and Medicaid started requesting providers to collect body mass index (BMI) data when obesity was first classified as an independent disease by the American Medical Association in 2013. This remains a primary health concern which is increasing with number of Americans, however when patients are not measured and weighed, this decreases the validity of the BMI data being reported. Obesity is an extremely complex issue that requires the monitoring of behavior, environment and genetics and Apple, along with other big tech companies, have been slowly moving to dominate this space. Optometry can be the gatekeepers of health and wellness and should be adapting management plans for obese patients during annual exams.

II. Course Objectives
   A. Understand Obesity
      1. The history and causes of obesity
      2. Body Mass Index
      3. Diabetes
      4. Cardiovascular Disease
   B. Apple’s Health & Wellness Game Plan
      1. Announcement
      2. Data
      3. Acquisitions
   C. How Optometry can become the Gatekeeper of Wellness
      1. Short Term Strategies
      2. Long Term Strategies

III. The History and Causes of Obesity
   A. One of the most pervasive, chronic diseases in need of new strategies for medical treatment and prevention. As a leading cause of United States mortality, morbidity, disability, healthcare utilization and healthcare costs, the high prevalence of obesity continues to strain the United States healthcare system.
   B. From 2011 to 2012, more than 34 percent of U.S. adults and nearly 17 percent of adolescents age 2 to 19 were obese, according to a 2014 study published in JAMA.
   C. More than one-third (36.5%) of U.S. adults have obesity.
      1. Non-Hispanic blacks have the highest age-adjusted rates of obesity (48.1%) followed by Hispanics (42.5%), non-Hispanic whites (34.5%), and non-Hispanic Asians (11.7%).
      2. Obesity is higher among middle age adults age 40-59 years (40.2%) and older adults age 60 and over (37.0%) than among younger adults age 20–39 (32.3%).
      3. Among non-Hispanic black and Mexican-American men, those with higher incomes are more likely to have obesity than those with low income.
      4. Higher income women are less likely to have obesity than low-income women.

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1 http://www.nytimes.com/2013/06/19/business/ama-recognizes-obesity-as-a-disease.html
2 http://www.obesity.org/obesity/resources/facts-about-obesity/what-is-obesity
4 https://www.cdc.gov/obesity/data/adult.html
5. There is no significant relationship between obesity and education among men. Among women, however, there is a trend—those with college degrees are less likely to have obesity compared with less educated women.

D. The estimated annual health care costs of obesity-related illness are a staggering $190.2 billion or nearly 21% of annual medical spending in the United States.5

E. A condition where a person has accumulated so much body fat that it might have a negative effect on their health.

F. Causes:
   1. Consuming too many calories
   2. Sedentary lifestyle
   3. Not sleeping enough
   4. Endocrine disorders (foods that interfere with lipid metabolism)
   5. Smoking Cessation
   6. Medications
   7. Genetics
      a) A faulty gene, called FTO, makes 1 in every 6 people overeat (Journal of Clinical Investigation July 2013)

IV. Body Mass Index6

A. A screening tool to indicate whether a person is underweight, overweight, obese or a healthy weight for their height, but not accurate enough to be used as a diagnostic tool.

B. Age-independent and the same for both sexes. BMI may not correspond to the same degree of fatness in different populations due to different body proportions.

C. The higher the BMI, the greater the risk of some diseases, including high blood pressure, coronary artery disease, stroke, osteoarthritis, some cancers, and type 2 diabetes.7

D. Formula:
   1. Weight (kg) / Height (m)²
   2. (Weight (lbs.) * 703) / Height (inches)²
      a) Underweight: Your BMI is less than 18.5
      b) Healthy weight: Your BMI is 18.5 to 24.9
      c) Overweight: Your BMI is 25 to 29.9
      d) Obese: Your BMI is 30 or higher

E. BMI Limitations8
   1. According to the NIH, BMI is accepted as a reliable indicator of total body fat but it does have some limits.
      a) It may overestimate body fat in athletes and others who have a muscular build.
      b) It may underestimate body fat in older persons and others who have lost muscle mass.

V. Diabetes

1. The urgency of the early detection of diabetic retinopathy9
   a. The advancing age of the US population makes the early identification treatable retinopathy an important contribution by the eye care professions.
   b. The CDC and US Census have both projected a year-to-year increase in the incidence of new diagnosis of Type 2 Diabetes (T2DM).

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5 http://www.nlc.org/health-and-wellness
6 http://www.medicalnewstoday.com/info/obesity/what-is-bmi.php
7 http://www.sutterhealth.org/health/bmi_calculator.html#
8 http://www.sutterhealth.org/health/bmi_calculator.html#
c. In 2015, the CDC estimated that 9.4% (or 30.3 million) of the US population had diabetes (Applying the rate found in NHANES to the estimated 2015 population)

d. 23.8% were undiagnosed

e. 87% of the people who had DM were >45%

f. The 45-64 age produces the most new diagnoses of DM (2x that of 18-44 and 2x of ≥ 65)

2. The rise in the cost of managing T2DM

a. The higher prevalence and incidence of DM increases the toll on society.

b. In 2002, the annual cost for diabetes was $132 billion. In 2012 that cost increased to $245 billion with annual expenditure. In 2017 the cost had increased to $327 billion

c. In 15 years, the cost has doubled.

d. In 2002, 12.1 Million people had been diagnosed with diabetes. In 2012, the number had increased to 22.3 million. By 2017, the number had swelled to 30.3 million.

3. Higher comorbid health conditions w/DM

a. ↑ prevalence and incidence of liver disease (El-serag, et al. 2004)

b. ↑ cardiovascular comorbidity irrespective to BMI but associated with activity level (Sullivan et al., 2005)

c. ↑ ischemia, infection and likelihood of foot disease and even amputation in diabetes. (Pompos, 2007)

d. ↑ Likelihood of medication non-compliance (Balkrishnan, et al, 2002)

e. ↑ prevalence of depression and other mood disorders (Katon, et al., 2009)

f. ↑ mortality from cancer in those with DM using insulin and sulfonylureas. (Bowker et al., 2006)

4. Risk Factors for Type 2 Diabetes

a. Modifiable

i. Low level of physical activity

ii. Weight gain from unbalanced caloric intake • Duration of diabetes

iii. In ability to control of glucose

iv. Hypertension

v. Pregnancy

vi. Smoking

vii. Cardiovascular risks

viii. H/O gestational diabetes

b. Uncontrollable

i. Gender

ii. Age

iii. Family history

iv. Economic status • Food security

5. Epidemiology - prevalence of BMI >25 in the US (Ng et al, 2014)

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a. It is estimated that excess weight is present in 91% of adult and 69% of children in the US. Worldwide, it is 86% and 52%, respectively (Maffetone and Laursen, 2017)

b. Men (OR ↑1.32, 95% CI 1.11, 1.58)/child borne in a family) gained more than women (↑1.15) for each child borne. (Brown et al, 2017)

c. In Pantalone et al. (2017), ICD diagnoses codes identified 37.4% to be overweight and 41.1% obese.

6. Pipeline of Disease & Escalating Costs (SOURCE: DHHS –“Epidemiology and prevention of Type 2 Diabetes” (E. Gregg PhD) CDC public domain)

7. How Diabetes Creates Vision Loss

VI. Cardiovascular Disease

1. The urgency of early detection of Cardiovascular Disease

a. Cardiovascular disease (CVD) is a major cause of morbidity and mortality worldwide, with the lifetime risk exceeding 60%.

b. More than 2200 Americans die of CVD daily, 1 death every 40 seconds. A third of CVD deaths occur before 75 years of age, which is less than the average life expectancy of 78.8 years.

c. Prevention of CVD is a public health priority. Major advances in cardiovascular epidemiology over the last 4 decades have improved our understanding of the pathogenesis of CVD, with the identification and treatment of several major risk factors.

d. Projections indicate that the prevalence of CVD in the United States may escalate by 10% between 2010 and 2030. The estimated increase stems in part from the aging of the population and is fueled by the recent trends for increasing obesity rates and the concomitant rising rates

12 https://www.ahajournals.org/doi/10.1161/cir.0000000000000350

13 https://www.ahajournals.org/doi/10.1161/cir.0000000000000350

of hypertension (8% increase over the next decade) and diabetes mellitus (100% increase over next 3 decades).\textsuperscript{15}

e. Diagnosing the different types: Bacterial, Viral, Allergic & Chemical

2. The Costs of Managing of Managing CVD\textsuperscript{16}
   a. The economic costs of CVD are high—more than $317 billion each year.
   b. Direct medical expenses were $193.1 billion per year on average during 2011–2012, and another $123.5 billion annually was attributed to lost productivity due to premature death from CVD.
   c. Treatment of CVD accounts for about $1 of every $6 spent on health care in this country.

3. Comorbidity with CVD\textsuperscript{17}
   a. One out of every four patients suffered from at least one CVD. Having one CVD increased the risk of another, co-occurring CVD and a higher number of other chronic diseases.
   b. Cardiovascular disease patients have increased risk for comorbidity: A cross-sectional study in the Netherlands
      i. Method: A cross-sectional study was conducted using data of 67,786 patients. Data were collected by the Registration Network Family Practices (RegistratieNet Huisartspraktijken, RNH). Comorbidities were analysed using chi-square and logistic regression analyses.
      ii. Results: At the time of study, 26.5% of the patients had at least one CVD and 10.5% of patients had two or more CVD diagnoses. The strongest association within cardiovascular diseases were between health failure and arrhythmias. Coronary artery disease and hypertension had strong relationship with diabetes and lipid metabolism disorders. The strongest associations for cerebrovascular diseases were with epilepsy and arrhythmias.

4. Risk Factors associated with CVD\textsuperscript{18}

5. How CVD Causes Vision Loss\textsuperscript{19}
   a. Arteriovenous nipping, narrowing of retinal arteries, and the dilatation of retinal veins are important signs of increased cardiovascular risk.

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\textsuperscript{15} https://www.ahajournals.org/doi/10.1161/CIRCULATIONAHA.116.023528


\textsuperscript{17} https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5795764/


\textsuperscript{19} https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3640200/
b. The pressure in the dilated veins is often markedly increased due to a dysregulation of venous outflow from the eye.

c. Besides such morphological criteria, functional alterations might be even more relevant and may play an important role in future diagnostics. Via neurovascular coupling, flickering light dilates capillaries and small arterioles, thus inducing endothelium-dependent, flow-mediated dilation of larger retinal vessels.

d. Risk factors for arteriosclerosis, such as dyslipidaemia, diabetes, or systemic hypertension, are also risk factors for eye diseases such as retinal arterial or retinal vein occlusions, cataracts, age-related macular degeneration, and increases in intraocular pressure (IOP).

e. Functional alterations of blood flow are particularly relevant to the eye. The primary vascular dysregulation syndrome (PVD), which often includes systemic hypotension, is associated with disturbed autoregulation of ocular blood flow (OBF).

f. Fluctuation of IOP on a high level or blood pressure on a low level leads to instable OBF and oxygen supply and therefore to oxidative stress, which is particularly involved in the pathogenesis of glaucomatous neuropathy.

g. Vascular dysregulation also leads to a barrier dysfunction and thereby to small retinal haemorrhages.

VII. Apple's Health & Wellness Game Plan

A. September 2017 during a keynote event, Apple’s CEO, Tim Cook, announced that “Health care is big for Apple’s future.”20 While healthcare providers (including optometrists), hospitals and pharmaceutical companies chase after reimbursements, Apple is capitalizing their best practice of “user experience,” with their control of both software and hardware. They are now translating it to patient experience to drive outcomes.

1. It was not long ago in 2013 when they filed a patent for a “Wellness Registry” (sound familiar?), and 2014 with the release of their Health App, ResearchKit and HealthKit on the iPhone, which later was expanded to Apple Watch.21

2. ResearchKit alone allows researchers to conduct large-scale studies using the iPhone. Along with their ability to scale current tools to streamline processes, Apple is gaining the attention of institutions and corporations.

3. Apple has also partnered with the American Heart Association, Dana-Farber Cancer Institute, Duke, Harvard, Yale, Stanford and many more to attract studies to utilize their platform and the CareKit app.

4. Researchers can track concussions, melanomas, postpartum depression, sleep health, heart attack recovery, children’s health care and managing diabetes and collect the data needed.22

B. Data

1. This data can now be analyzed and used to predict outcomes to define who is high and low risk, which is exactly what health insurers want to control costs.

2. The data from the Apple Watch health sensors already determines your heart rate, pulse, how much exercise you have done, how many steps you take per day, how long you sleep, etc. which is currently transforming the health insurance industry. Insurers underwrite this risk, and if you can lower your risk from utilizing these technologies, consumers could have lower health insurance premiums.

3. Vitality, a UK health and life insurance company, already offers their members a discount on their premiums who use the Apple Watch to track their activity.23 Aetna, which in the middle of acquiring


22 https://www.apple.com/researchkit/

23 https://www.vitality.co.uk/
the drugstore giant CVS, is planning to give away more than 500,000 Apple Watches in 2018 to their employees so they can test apps that will integrate with their wellness programs.\(^{24}\)

4. Primary health care providers have been collecting some of this data for years, so why wouldn’t health insurers utilize their network of physicians who they currently reimburse? One answer is, numbers! The larger the sample size, the more statistically accurate your predictive analysis is. In 2016, United Healthcare had 47.5 million medical enrollees, Anthem had approximate 34 million and Aetna had about 20 million.\(^{25}\) For each insurer, that does not compare to Apple’s 2016 iPhone users of 85.8 million. Additionally, not all members utilize their annual benefits which yields less data for actuaries and data scientists who build predictive models for insurers. So, Apple has a lot of leverage with their numbers and scalability.

5. Secondly is the type of data physicians (including optometrists) collect versus how sensors from wearables collect. As optometrists, we subjectively collect medical history, medications, visual acuities, BMI, etc. while technology gathers it objectively. CMS started requesting BMI from providers when obesity was first classified as an independent disease by the American Medical Association in 2013.\(^{26}\) When patients are not measured and weighed, this decreases the validity of the BMI data being reported.

6. Subjective data is time consuming to collect, while objective measurements are quick. Technology allows objective data to be captured in real-time! As optometrists, we recommend patients to return for an annual exam, however patients are not returning that timely. Therefore, there are gaps within the data set they collect.

C. Acquisitions

1. In August 2016, Apple quietly bought Gliimpse for $200 million. And no, this is not Glimpse the optometric business analytics company. Gliimpse (spelled with 2 “i”s) was a silicon valley start-up that built a platform which focuses on personal health data. The platform was a simple concept where everyone should manage their own health data and to share it securely whom they trust.\(^{27}\) Apple has not formally announced how it would integrate Gliimpse’s platform, but their Health app now captures a larger array of clinically relevant data. If you have a newer version of the iPhone, you will see that the Health App tracks, and quantifies wellness from physical activity, mindfulness, nutrition and sleep, along with other biomarkers like glucose levels.\(^{28}\)

2. In May 2017, Apple made another acquisition for $200 million and purchased Lattice Data, Inc., a “dark data” startup company.\(^{29}\) I understand this sounds extremely Star Wars-esque. “Dark data” is data that has been collected through computer operations that has not been used to derive insights or for decision making.\(^{30}\) Because the collection of data is much faster than the analysis, companies may not be aware how much data they have collected. IBM estimates that 90% of data that is collected from sensors never gets used.\(^{31}\)

3. Apple acquired SensorMotoric Instruments June 2017.\(^{32}\) SMI, the German based company, was founded in 1991 designed Eye Tracking Glasses (ETG) which is based on dark pupils and corneal


\(^{26}\) http://www.nytimes.com/2013/06/19/business/ama-recognizes-obesity-as-a-disease.html

\(^{27}\) https://www.crunchbase.com/organization/gliimpse

\(^{28}\) https://www.apple.com/ios/health/

\(^{29}\) http://www.mobihealthnews.com/content/apples-new-ai-acquisition-has-some-healthcare-experience

\(^{30}\) https://en.wikipedia.org/wiki/Dark_data

\(^{31}\) https://siliconangle.com/blog/2015/10/30/ibm-is-at-the-forefront-of-insight-economy-ibminsight/

reflections by infrared sources, which then calculates eye movements and gaze. This technology can be used for virtual and augmented reality, which was released in on the iPhone X.33

VIII. How Optometry can become the Gatekeeper of Wellness

A. Short Term Strategies
1. Optometrists’ short-term strategies currently have been focused on insurance reimbursements, expansion of medical eye care and disruptive technology. This is a vicious cycle between payers and providers.
2. The rising of cost of care and the lowering of reimbursements is a “lose-lose” situation, or a zero-sum game. Providers try to negotiate higher reimbursements with payers, but payers have not experiencing a decrease in expenses.
3. Optometrists have the education and training as primary care providers to manage wellness as other allied health professionals do. They should be collaborating with nutritionists, dietitians and exercise specialists, in addition to neurologists and rheumatologists.
4. Optometrists have the capability of monitoring blood pressure and BMI just as tech companies do.
5. ODs have something additional to offer which tech companies cannot; and that is the management of care, and the ability to obtain subjective data to “fill-in” the gaps of objective data.

B. Long Term Strategies
1. Optometrists’ long-term strategy has been to expand their scope of practice and provide medical services, but this is still not sustainable.
2. If increasing costs of care leads to lower reimbursements, logically it does not make sense to only focus on expanding scope of practice of medical eye care.
3. If shifts to lower insurance premiums for members is through wearable trackers and sensors, then optometrists should work with patients and insurers to manage the data collected by these devices.
4. Why can’t they prescribe a wearable technology for an obese or diabetic patient? Shouldn’t it be considered unethical if they didn’t? Where is it written that offices cannot sell wearables and other health monitoring devices?
5. This opportunity will allow ODs to embrace telemedicine and collaborate with Telehealth applications to monitor the data from these devices effectively to manage obesity, diabetes, hypertension, etc. This now presents a win-win-win strategy for everyone; providers, payers and patients.