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# I Have a Dream



For the first time in our lives, it appears that there is a global opening in the continued flow of time. COVID-19 forced everybody on the planet to stop and think. Many

lessons can be learned from the pandemic; as someone once said, “You never let a crisis go to waste.”

In the U.S., the crisis hit every aspect of our health care system, revealing many weaknesses. Non-urgent procedures and “routine” visits were canceled in preparation for COVID-19 patients. Overnight, the patients disappeared but their health problems did not go away. We were not prepared for that. But, as we were looking for a new model of care delivery, telemedicine emerged as the solution to the new reality of social distancing.

Again, COVID-19 acted like a midwife delivering a new model that had been in gestation for decades. Prior to March 2020, telemedicine appeared as a remote possibility; technical and administrative hurdles seemed insurmountable. But as “Humanity solves the urgent problems that life places on its agenda,” we saw the obstacles disappearing by miracle. Many institutions are now back to almost full operation with some patient encounters happening in person and many more using telemedicine. The patients seem to like it; but this form of patient care has its limitations. Its reason to be, social distancing, is also its Achilles heel.

The physical exam is impossible and the healing, compassionate touches of the doctor and nurse are gone. Meaningful proxemics have been lost. Establishing trust and having difficult conversations might be complicated and often undermined by the distance and technology. What will be the shape of our medical care after COVID-19? The future will tell, but this form of health care

delivery is here to stay. We have swiftly adapted and will continue to do so.

The other weakness of our health care system is the exaggerated focus on medicine for the individual – who can pay – to the detriment of public health, which deals with populations. Public health tackles the fundamental components of a population such as job, food and housing security, screening and prevention of diseases, life style, and mental health. The common thread to social determinants of health is the availability of publicly funded programs and universal health coverage for the entire population. All developed nations and most developing nations provide universal health care coverage, with strong public health components, to all their citizens. The U.S. is the exception. Although the virus did not discriminate between poor and rich, the heaviest burden landed on the shoulders of the poorest and most vulnerable amongst us. This magnified preexisting deficiencies. This pandemic should close the debate on whether universal health coverage is needed and whether public health programs should be funded. The costs of these programs dwarf when compared to the cost in lives, quality of life, and financial impact when the crisis hits.

Our medical education programs quickly adjusted to this new reality and moved to an “all-distant learning” model. Virtual learning is not new, but COVID-19 gave it new, unprecedented dimensions that will impact our educational institutions for years to come. We are still struggling to find the right format to teach and assess knowledge and redefine a new collective graduate education experience that, in the past, benefited from the live interactions between a diverse student body and its teachers.

Starting in mid-January and for several weeks afterward, COVID-19 synchronized billions of human lives into a state of immobility in their homes; the result was a shutting down of major economic activities across the globe. A few weeks later, specialized centers recorded a drastic drop in daily global CO<sub>2</sub> emissions (–17% by early April 2020 compared with the mean 2019 lev-

els), with just under half from changes in surface transport. This ‘global social experiment’ proved that we are responsible for what happens to our planet and we can effect a change if we decide to do so. Of course, nobody is talking about any form of lockdown or confinement. But, imagine what would happen if we replace half of our fossil-fuel-powered cars with electric cars powered by renewable energy. Would we not get the same results? The answer is a resounding yes.

As we are working our way out of the muddy COVID-19 territories, racial injustice against our black citizens has flared up. Four centuries after the beginning of slavery in the U.S. and more than 155 years after its abolition, our nation has not yet come to completely eradicate racism. Institutional racism leads to weak social determinants of health, which explains the heavy burden paid by our black communities to the pandemic (blacks represent 13% of the population in the states that reported COVID19 race data and about 34% of total COVID-19 deaths in those states.). To correct the effects of this historical injustice, we need to acknowledge and dismantle the social, economic, cultural, legal, and political underpinnings of discrimination.

We’ve gotten used to our life with all its deficiencies, but our ‘normal life’ isn’t that normal. I have a dream today that we will take advantage of this seismic event to peacefully reinvent our health care system, society, economy, and governing structures to be more just and in harmony with nature and to respond to our deep human needs for life, love, and peace for ALL. COVID-19 uncovered our vulnerabilities and abilities. History is tolling its bell. Are we ready to answer its resounding tone?

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# Market Forces and Evolving US Health Care System: Economics and Winds of Change

The health care industry in the U.S. is undergoing significant transformation. To an extent, this is a response to macroeconomic and resulting market forces. Despite being the highest spender on health care (\$3.7 trillion in 2018), the U.S. lags behind most developed countries in key quality clinical outcomes.<sup>1-3</sup> Unfortunately, politicization during the last several decades and overzealous, competing special interest groups have stalled legislation. This has resulted in our failure to develop long-term comprehensive health care policies that address unique demographic population needs and respond to current market forces. Despite legislative inertia, many intrinsic and extrinsic macroeconomic market forces in this capital driven economy are impacting growth and affecting the direction of the health care industry. Collectively, these forces will play a pivotal role in transforming health care as we know it today.

The traditional Fee-For-Service (FFS) reimbursement model is evolving towards Pay-For-Performance (PFP). This model, which over time had encouraged overutilization and, to an extent, contributed to total health care cost, is responding to market needs. The simultaneous shortage of primary care providers and a lack of meaningful financial incentives for added emphasis on preventative care is also leading the transition towards PFP model. The absence of incentives to strive towards uniformly accepted, meaningful quality outcomes and a minimal recognition of adverse long-term impacts of social determinants of health (including adverse childhood experiences) are thought to contribute towards low health care equity in the U.S. To an extent, the culture that lacks adequate emphasis on patient accountability also contributes to enormous chronic disease burden. Unfortunately, overtime, this aspect has added to a significantly higher burden of chronic diseases within specific population segments and increased the total cost.<sup>1</sup> It is hoped that soon, market-driven changes in reimbursement model, incentivized awareness, and added emphasis on

population health will drive this transition from FFS to PFP model.

To cut costs while retaining their market share, hospitals are merging and consolidating. Horizontal consolidations have led to the evolution of health care systems. In addition, the traditional clinical practice model is in decline and evolving from solo or small physician groups towards either contractors or employees of health care systems. This is a fundamental change in operating model, relieving physicians from administrative burden of running practices and dealing with complex regulations. To continue to control their supply chain and create competitive advantage, various stakeholders in health care (e.g., hospitals, pharmacies, and bio-medical/drug manufacturing) are also exploring vertical consolidations. For example, the pharmaceutical chain CVS is strategically evolving and targeting the retail market segment by expanding into delivery of primary- and urgent-care needs at the retail level (Minute Clinics); in addition, groups of select hospital systems are cautiously expanding into drug manufacturing (e.g., Civica) to ensure the supply of uninterrupted generic drugs at low cost and the decreased overall cost of delivery of clinical care.

Patient consumerism is a powerful, intrinsic market force that is changing expectations and demanding added value with a positive health care experience. Today's patients are well connected on social media and equipped with knowledge; as such, they are now active partners with their physicians in making health care decisions. The active consumerism that other service industries experienced during the last 15-20 years has now reached health care – something providers and payers cannot ignore. Patients today demand high-quality care, price transparency, and comparable outcomes. In a choice-driven, competitive market, we find that clinical outcomes, patient experience, and satisfaction are pivotal for

every practice. To a significant extent, this active consumerism is driven by easy access to data and advances in information technology. On the health care delivery side, sophisticated analytics, generation of Big Data, and improvements in learning algorithms is leading to adoption of artificial intelligence and machine learning. It is expected that this will not only enhance care and delivery processes, but also improve overall safety, improve efficiency in health care system, and augment physicians at the bed side. Other than uniformly adopting electronic medical records (EMR), compared to other industries, medicine and health care in general has significantly lagged in adopting technological advances, especially in information technology. With active consumerism and transformative technological advances, these market forces have also paved the way to increased accountability and price transparency. The pharmaceutical industry is being scrutinized for fair drug pricing, and hospitals are expected to be transparent with medical billing. The retail cost of drugs is very high in the U.S. and, when combined with increased demand and high utilization, this factor significantly adds up towards an enormous per capita health care cost (\$11,212 in 2018) that is almost double than most comparable developed economies.

These inherent market needs and resultant forces offer unique opportunities for entrepreneurs to experiment with technological advances and offer unique products and creative services. For example, for their combined 1.2 million employees, Amazon, Berkshire Hathaway, and JP Morgan have joined to form a health care consortium that is poised to be an impactful player and a market disruptor. The resultant enterprise, Amazon, aims to create a health care system that is efficient and value-based and that delivers quality outcomes at a fraction of the current cost.

The biggest economy in the world, the U.S. spends almost 18% of its gross domestic prod-

uct (GDP) – the highest in the world – on health care for its citizens. With an annual growth rate of 3-5%, most economists warn that this expense-based growth, if not checked, will not be sustainable in the long run and that cumulative deficit may even be detrimental to the whole economy and eventually pose a national threat. The majority of developed countries spend 8-10% of their respective GDP on health care and deliver better outcomes on most quality domains. In addition to being a burden to the U.S. economy, the enormous cost of health care also has consequences on a personal level. Rising cost and increased deductibles (160% growth over last 10 years) has led to financial hardship for consumers. An estimated 30-40% of our patients struggle to pay their health care bills. Inability to pay hospital bills is the leading cause of personal bankruptcy in the U.S.<sup>3</sup> To have meaningful impact within a reasonable timeframe, health care legislation and reforms are urgently needed, both at the state and federal level. Increased consumer awareness and appropriate provider's activism may be crucial to end deadlock and inertia. No one disputes that an open and honest debate, willingness to find common ground, and putting patient first are keys to ending a stalemate at the legislative level. Market forces need long-term legislative policies as a guide and patient care delivery needs oversight. Population segments with adverse social determinants of health require a long-term, multifaceted approach and social support; these are things a market-driven capitalist economy frequently ignores. Let there be no doubt that we as today's providers will very likely be tomorrow's consumers. Before we reach the receiver's end of our own health care system, let's do our part for a meaningful action. Yesterday was the appropriate time. Today may not be too late, but tomorrow definitely will be.

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# School and Early Childhood Nutrition in Arkansas

## Nutritional Needs in Children

Nutrition is an integral part of children's growth and development; proper nutrition is associated with improved health and academic performance. Poor childhood nutrition can have devastating consequences.<sup>1</sup> Poor nutrition is associated with childhood and adult obesity;<sup>2</sup> childhood and adult chronic illness such as hypertension, diabetes, cardiovascular disease, stroke, and sleep apnea;<sup>2</sup> poor academic performance;<sup>3</sup> and mental and behavioral health concerns, including depression and anxiety.<sup>4</sup>

Most children are not getting the nutrition they need to thrive. Fewer than 10% of American students meet recommendations for fruit intake, and only 2% meet the vegetable recommendations.<sup>5</sup> Almost 40% of total calories consumed by children and adolescents are in the form of empty calories (added sugar and saturated fat).<sup>6</sup> Sixty percent of youth consume a sugar-sweetened beverage daily, contributing an average of 143 calories to their daily caloric consumption.<sup>7</sup>

The results of poor nutrition are seen in the rise in childhood obesity, which has doubled in the last 40 years. National rates of childhood obesity are at an all-time high. One-third of school-aged children and one-quarter of children aged two to five are now categorized as overweight or obese.<sup>8</sup> The problem is even more significant in Arkansas, where 31% of kindergarteners and 39% of all students are overweight or obese.<sup>9</sup> Nationwide, Arkansas has the highest rate of obesity for children in grades nine through 12.<sup>10</sup>

## School and Early Childhood Education Nutrition

Sixty percent of preschoolers in the U.S. spend an average of 26 hours per week in early childhood education settings (ECEs), where they consume at least one meal and one snack per day and most consume two meals and two snacks.<sup>11</sup> Children aged five to 18 consume more than 50% of their daily caloric intake in schools.<sup>12</sup> This makes ECEs and schools excellent places to improve nutrition. These settings are even more important for low-income children, who receive the majority of their daily nutrition from early childhood centers and schools.

School districts in California, Connecticut, and Maine have implemented successful nutrition interventions and have seen a range of positive results. These results increased consumption of vegetables, reduced consumption of sugar-sweetened beverages, and reduced consumption of other, less healthy foods. Most importantly, results indicated healthier BMI trajectories.<sup>13</sup>

## Barriers to School and Early Childhood Education Nutrition

While schools and early childhood centers are ideal locations for addressing childhood nutrition, school districts and ECEs face challenges that create significant barriers to providing nutritionally-sound meals. UAMS has met with 200 representatives from more than 120 schools to understand their interest in, motivation for, and challenges in implementing nutritional improvements. Overall, the majority of school districts are interested in and motivated to improve nutrition, but schools face several challenges. The most consistent challenges voiced by school district leaders include budgetary constraints, insufficient staff trainings, and lack of customized solutions.

UAMS is working with schools and ECEs to address the barriers and ensure that they are empowered to meet children's nutritional needs through the implementation of a Comprehensive Nutrition Enrichment Program (Nutrition Program). UAMS provides nutrition expertise to make changes manageable, successful, and sustainable. School districts and ECEs have significant choice in how they engage in the Nutrition Program. The customized nutrition program allows school and ECE leadership to choose the right strategies for their students and allows UAMS to develop individualized plans, policies, and procedures based on each site's specific needs. The Nutrition Program does not provide a generic menu or procurement list but instead works with each school district and ECE's current food vendors, budget, and meal patterns to make customized nutritional changes that will have significant impact and are sustainable for the school district or ECE. The Nutrition Program is implemented in three phases: engagement, implementation, and sustainability.

## Engagement

The engagement phase includes baseline evaluation, engaging with stakeholders, assessing the food environment, and customizing nutrition plans. Baseline evaluation is collected at each school, and ECE and is used to target program activities toward the areas of greatest need.

UAMS works with each participating school district or ECE to identify a core implementation team. This team typically includes food preparation staff, teachers, students, and parents.

To assess the schools and ECEs' food environments, UAMS partners with the child nutrition director to assess infrastructure needs and conduct behavioral economics assessments. This helps UAMS work with the specific needs of each location and better identify opportunities and barriers that exist. Based on this assessment, UAMS develops customized nutrition plans for each school/ECE. The customized plans are designed to meet individual needs at each school or ECE.

## Implementation

The implementation phase includes meal and menu modification, adjustment of procurement practices to optimize nutrition, staff training, and behavioral economic strategies to help nudge healthier choices. In order to create modified meals and menus, the UAMS evaluation team uses baseline data to identify the least nutritious meals and items on the menu being served in each location and recommends menu modifications to improve nutrition (e.g., ingredient substitutions, increase fruit and vegetable offerings, limit simple/processed carbohydrates and sugars, and increase water consumption). Menu modifications are customized to meet the budget and staffing constraints. See Table 1 for examples.

UAMS conducts an in-depth review of each school and ECE's procurement histories, bid processes, and purchasing contracts to develop customized recommendations regarding the procurement process that results in more nutritious food pur-

**Table 1**

Meal	Modifications	Nutrient Composition % Change	Cost Difference
Chicken Ranch Wrap (Middle, Junior and High Schools)	The modified recipe uses salt-free seasonings on grilled chicken strips instead of breaded chicken tenders and adds carrots and romaine lettuce	The total fat decreased by 69%, sodium by 44.63%, and sugars by 39%, while adding fiber, potassium and vitamin C.	All the products swapped or added to this meal are already stocked in school cafeterias. This meal modification would be cost-neutral.
Classic Macaroni & Cheese (Elementary School)	The modified recipe maintains the 'base' cheese sauce and adds blended steamed carrots and squash, which dilutes the fat and sodium with fibrous vegetables. The Classic look and taste of Macaroni & Cheese is maintained while improving its nutrition.	This total fat decreased by 33%, sodium by 15%, while adding more fiber and vitamin A.	This meal utilizes commodity-frozen vegetables. This modification produces a cost savings.
Meatloaf (Elementary, Middle, Junior, and High Schools)	The modified recipe swapped the bread crumbs for lentils and added blended vegetables.	This menu item's total fat decreased by 5%, sodium by 50%, and sugars by 67%, while increasing folate, fiber, and many essential vitamins.	Red lentils are an additional purchased item; however, bulk purchases of lentils are more cost effective than bread crumbs. This meal adjustment costs less than the original recipe.

chases. UAMS also provides customized trainings for child nutrition directors and food preparation staff on new techniques for integrating healthier options into their meals (e.g., knife skills; how to present and offer fresh fruits and vegetables; utilizing spices, lemons, and vinegar to flavor meals without adding fat, sugar, or sodium).

Finally, UAMS utilizes the Smarter Lunchrooms Scorecard<sup>14</sup> to make environmental adjustments in how foods are presented to student diners in order to nudge them towards healthier choices (i.e., behavioral economics). Examples include flavor stations (e.g., herbs and spices available for individual seasoning preferences), placing plain milk before chocolate and strawberry milk, and offering both fresh and prepared vegetables to diners. Behavioral economics is more important in schools, rather than ECEs, where students have greater opportunities to make their own choices with respect to the food that they eat in the lunchroom.

**Sustainability**

To ensure sustainability, the Nutrition Program includes nutrition and policy guidelines development, sustainability plans, evaluation data review, and strategies for media and messaging. UAMS works with the core implementation team at each school and ECE to develop and implement nutrition policies and guidelines and sustainability plans that increase

access to healthier foods and ensure the continuation and maintenance of healthy food offerings.

UAMS presents an annual review of evaluation data to school and ECE leadership and administration and the core implementation team. Evaluation data include information on changes in nutrition across all foods served and in specific meals and menu items, numbers of students reached and numbers of meals and menu items served, and fidelity to the practices and/or guidelines each school or ECE has chosen to implement. This analysis provides a comprehensive overview of changes resulting from the Nutrition Program.

Additionally, UAMS works to develop a customized marketing and messaging campaign to highlight the nutritional changes that the school districts are implementing. For example, parents can be reached via communication folders sent home with children, school social media accounts, and school-district texting. UAMS also engages students in developing message campaigns to create excitement around new school meals. One example of this work includes Springdale School District's sodium reduction efforts. For one year, the district used the methods described above to lower the mean sodium content per meal from 1103 mg to 980 mg (-11.2%) from baseline to one-year follow-up. This change represents clinical significance for child health.

The sodium reduction intervention had a reach of ~20,000 students and ~4,000 adult diners (staff, teachers, and family members eating at school) per day across all 30 Springdale schools. This work has been cited in U.S. congressional testimony.<sup>15</sup>

**Conclusion**

Nutrition during childhood is critically important for growth and development across the life course. Schools and ECEs are important venues for nutritional changes. UAMS is partnering with schools and ECEs to improve children's nutrition environment, which has the potential to create immediate and long-term health improvements in childhood obesity in Arkansas.

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# Resource Update for Traumatic Brain Injury Patients

TERRI IMUS, RN, BSN, and KIM LAMB, MS

Each year, approximately 25,000 Arkansans are treated in emergency departments for a traumatic brain injury (TBI).<sup>1</sup> Of those injuries, about 400 are moderate to severe. Within a year following their incident, 22% of TBI patients are readmitted to the hospital.<sup>2</sup> The high level of hospital readmissions is frequently due to the number of TBI survivors who live in rural or medically underserved areas of the state.

The Centers for Disease Control and Prevention (CDC) defines a TBI as a disruption in the normal function of the brain that can be caused by a bump, blow or jolt to the head or a penetrating head injury.<sup>3</sup> Nationwide, approximately 2.5 million Americans a year experience a TBI-related injury serious enough to visit an emergency department.<sup>4</sup>

Treatment of TBI survivors in Arkansas significantly changed with the development of the Arkansas Trauma System (ATS) in 2009.<sup>5</sup> The Arkansas Department of Health assumed management of the ATS and its related programs in 2010. Reporting TBIs to the ATS became law in 2010.<sup>6</sup> Public and private health and social agencies and attending physicians are now

required to enter newly-identified, moderate-to-severe TBIs into a statewide registry — the Arkansas Traumatic Brain Injury Registry (AR TBI). The AR TBI Registry was launched in 2013 with the help of the Brain Injury Alliance of Arkansas and the Arkansas Spinal Cord Commission. It is managed by the University of Arkansas for Medical Sciences (UAMS) under the administration of the Institute for Digital Health & Innovation (IDHI).

Since 2013, the AR TBI Registry has documented 2,450 moderate-to-severe TBI injuries in Arkansas. Plans are to expand the registry to include acquired brain injuries that are not hereditary, congenital, degenerative or induced by birth trauma<sup>7</sup> and mild brain injuries, known as concussions. Data gathered from follow-up services and the AR TBI Registry enable other agencies and organizations to plan TBI prevention and recovery efforts.

Providing services and support to all TBI survivors could potentially improve the quality of life for thousands of Arkansans. Individuals documented in the TBIR receive follow-up care, including resources and guidance to help them return to

work or school and attain the highest possible level of independence. Follow-up care includes discussions with adult survivors, their caregivers and family members who can provide a unique perspective about survivors' needs.

In 2018, UAMS received grant funding from the Administration for Community Living Traumatic Brain Injury State Partnership Program (SPP). The SPP grant has helped improve resources and care via a statewide advisory board, state plan, developing a trust fund/waiver program and outreach to TBI survivors in underserved and rural areas. The advisory board workgroup meets quarterly to learn about legal concerns, provider reimbursement funds, housing assistance and private fundraising.

The SPP grant provided funding to develop a statewide plan. Data for the plan is collected on the TBI website,<sup>8</sup> surveys of survivors and stakeholders, and discussions with treatment staff. Once complete, the statewide plan will provide goals and recommendations to provide case management, increase access to rehabilitative services, and develop a trust fund and/or waiver program to

assist in funding for services that are needed but not affordable for some individuals living with a TBI.

Grant funds are also used for outreach to identify and contact TBI survivors to assess individual needs, help connect them to local resources and provide follow-up care and guidance.

Many TBI survivors, caregivers and family members are unaware of available resources. In May 2019, a series of four regional Brain Injury Regional Workshops was launched to take resources into rural areas where many TBI survivors live. In Arkansas, 73 of the state's 75 counties have medically underserved communities.

One regional workshop featured TBI survivor Crystal Payne, who shared her recovery journey. Payne said, "Sometimes we are given challenges in life that we just don't understand, but you have to give it 100% to defeat that challenge so you can help someone else get through their challenges." While relating her story, she was reunited with the flight paramedic who had responded to her accident scene.<sup>9</sup> The workshops engage a diversity of speakers and offer an opportunity to visit with resource representatives while networking with others in the TBI community.

J.P. French, director of strategic accounts for Rave Smart 911, says, "The brain injury regional workshops are the most rewarding on a personal level. I talk to survivors and caregivers about Smart 911 services, and I can see in their faces that (it) will expedite assistance when they need it most." When an emergency call is received from a TBI survivor, Smart 911 equips first responders with injury-related information that can assist their delivery of emergent care.

Stakeholders who participate in the regional workshops include the Social Security Administration, ICan (Assistive Technology), Smart 911, Independent Living Services, Arkansas Department of Human Services ombudsman program, Canine Companions for Independence, Arkansas Rehabilitation Services, Arkansas Disabilities Rights and others. More workshops are planned for fall 2020 if group meetings are permitted by then. A forum was also held with representatives from the Provider-Led Arkansas Shared Savings Entity (PASSE) system to discuss the impact of TBIs and scarcity of services for this population.

The SPP grant has been invaluable in realigning care for TBI survivors, through increased access to resources, bonding within the TBI community and follow-up care. One key aspect of follow-up care is access to a 24/7 nurse-staffed call center. The call center gives survivors, caregivers, family and providers access to nurses for the immediate triage of needs. The call center extends an unprecedented level of individualized outreach to survivors and providers.

UAMS' IDHI has increased telehealth opportunities for survivors and providers across Arkansas. It has increased access to other health care professionals who can assist with the evaluation, diagnosis and treatment of TBI patients, especially those in underserved areas. UAMS' Learn On Demand<sup>10</sup> web portal offers educational opportunities for health care providers who serve the TBI population.

Strengthening the statewide TBI infrastructure will continue by studying other states' TBI services and integrating needed services into Arkan-

sas' TBI system. There has never been greater awareness in Arkansas about the needs of TBI survivors, and there have never been more resources to help survivors attain independence and quality of life. ▲

*Ms. Imus is clinical director, IDHI Go Live Team at UAMS. Ms. Lamb works with the TBI State Partnership Program at IDHI, UAMS.*

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AUGUST 2020

# A Case of Acute Respiratory Failure Due to Vaping

## Abstract

The toxic substances in the oils that are inhaled with vaping have been found to cause serious lung injuries in patients across the nation. Here we present a 25-year-old male who suffered from respiratory failure from inhalation of these toxic substances. He was diagnosed based on his imaging studies and deteriorating clinical presentation. His symptoms resolved with the addition of steroids to his treatment regimen. This case is significant because of the increasing use of E-cig-

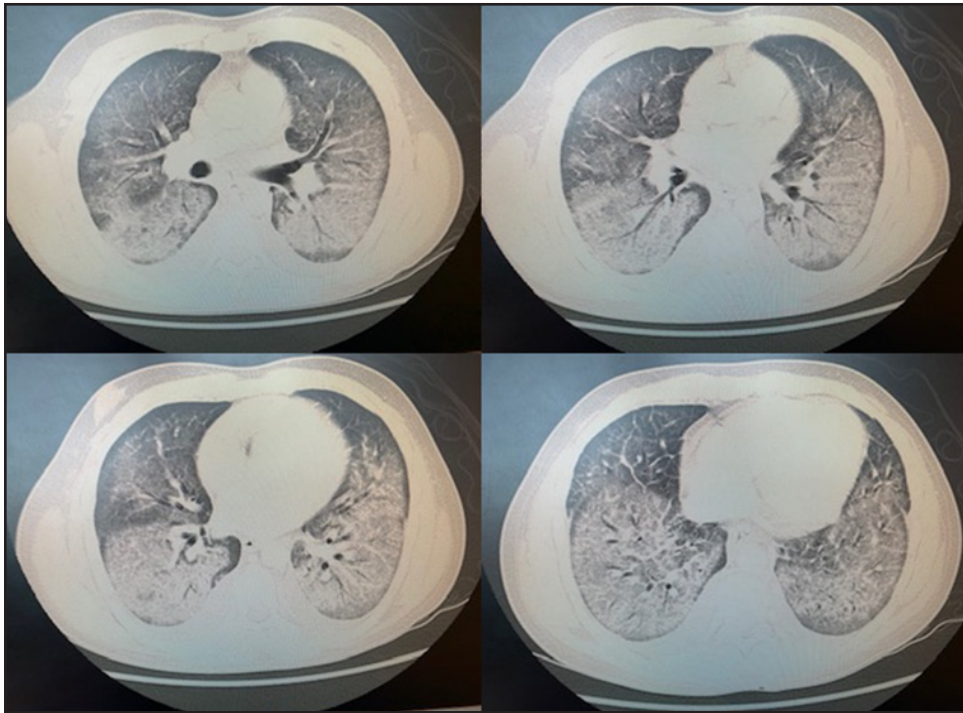
The symptoms and radiological findings related to these cases have been found to be similar to one another. The symptoms are usually flu- or pneumonia-like, including nausea, vomiting, dyspnea, and coughing. They may vary due to the amount or type of toxic chemicals that have been inhaled. Two of the substances in the E-cigarette oil (diacetyl and 2,3-pentanedione) have been shown to cause problems with gene expression of cilia in the airways of patients.<sup>1</sup> A 25-year-old man with a history of vaping presented with acute respiratory

A 25-year-old male presented to the emergency room with shortness of breath, nausea, and vomiting and was diagnosed with left-lower-lobe pneumonia. He was treated with anti-emetics, fluids, and Levaquin and was discharged in stable condition that evening. The following day, his symptoms of dyspnea, nausea, and vomiting worsened and he subsequently returned to the ER. His oxygen saturation on room air was 88%, and he was tachycardic at 115 beats per minute. The chest CT showed patchy, bibasilar interstitial and airspace infiltrates bilaterally, which was diagnosed as multifocal pneumonia. The patient was admitted to the hospital and started on IV antibiotics (IV rocephin and IV zithromax).

Upon questioning, the patient admitted to cigarette smoking as well as THC-based vaping on a regular basis. He had been working in a chicken coop for the past few weeks with exposure to live animals placing histoplasmosis on the list of differentials. His main complaints were dyspnea, coughing, nausea, vomiting, dry heaving, and pleuritic chest pain. Of note, his nausea and dry heaving were likely due to THC withdrawal. On physical examination, crackles were auscultated bilaterally with decreased chest wall expansion and diminished breath sounds.

After a few days of inpatient care, the patient remained short of breath and required supplemental oxygen. Lung imaging had worsened with time, showing diffused bilateral lung opacities. After consulting with pulmonology, the patient was started on IV steroids. Pulmonology also recommended bronchoscopy, with brushing biopsy and BAL. The procedure was performed and Bronchoalveolar lavage (BAL) with brushing biopsy was obtained from the posterior segment of the right lower lobe and sent to pathology. Thin mucus plugging was found in the airways and subsequently suctioned.

After six days of treatment with IV antibiotics



**Figure 1. Computed Tomographic Scans of the Chest: A Case of Acute Respiratory Failure due to Vaping**

arettes and vaping in our country right now. The number of vaping-related deaths is increasing, and the question of banning e-cigarettes is an ongoing discussion.

## Background

The CDC has reported that vaping-related lung injuries and deaths have been increasing rapidly.<sup>3</sup>

failure and quickly progressing lung injury. The radiographic images of his lungs show diffused interstitial and airspace infiltrates, similar to the other vaping cases recently reported in the New England Journal of Medicine.<sup>1</sup>

## Case

and the additional steroid treatment, the patient's symptoms had markedly improved. His cough was much improved and pleuritic pain was minimal. Chest x-ray showed slight improvement regarding the bilateral lung opacities. The patient was discharged and sent home on two liters of oxygen via nasal canula and oral prednisone tapered for the next three days. He was advised about the danger and growing epidemic of vaping-related lung injuries and counseled to abstain from these activities.

### Discussion and Conclusion

The differential diagnoses for this case include bilateral pneumonia related to vaping, bacterial infection, fungal infection (possibly histoplasmosis due to his exposure to live chickens), acute eosinophilic pneumonia, acute interstitial pneumonia, aspiration pneumonia, and hypersensitivity pneumonitis.<sup>1</sup> The patient's history of vaping THC and his clinical presentation make vaping-related lung injury the probable cause of his acute respiratory failure. The fungal and bacterial blood culture results were negative, further supporting this. The pathological report found no evidence of fungal growth, thus ruling out histoplasmosis. Pathology showed reactive lung parenchyma with

histiocytes and fibrin deposition. These histologic changes may indicate that these inhaled toxic substances in E-cigarette oil can cause a chemical pneumonitis.<sup>2</sup> The cases of vaping-related lung injury have been so severe that they have caused the Trump administration and state governments to consider regulating E-cigarette sale and use.<sup>3</sup> This is an epidemic and is especially dangerous as vaping has become increasingly popular among teenagers and young adults.

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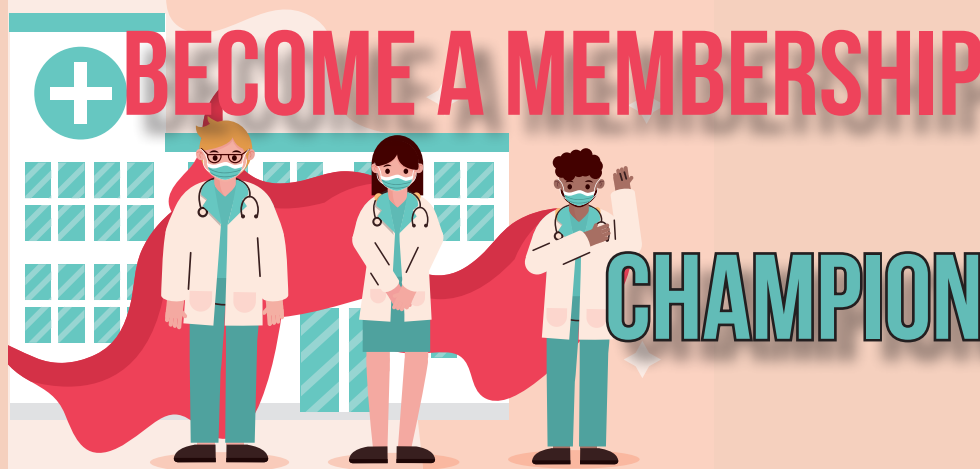
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