International Healthcare Opportunities for Virginia Defense Companies

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The International Healthcare Sector: Opportunities for Virginia Defense Companies
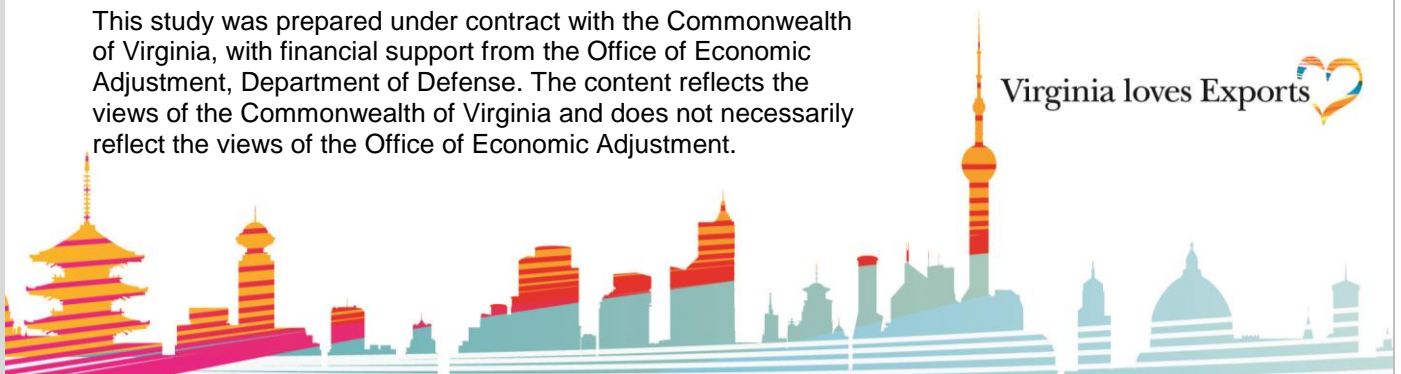
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CONTEXT OF THE ANALYSIS

DEFENSE CONTRACTOR AREAS OF EXPERTISE THAT OVERLAP INTO GLOBAL HEALTHCARE

It may be hard to envision where defense industries and healthcare industries and their respective markets overlap. Defense industries, internationally, are typically about weapons and their delivery, mobilization, security, and the inherent support of these things that must occur in both peacetime and in times of conflict. Internationally, every nation's defense structure includes some level of healthcare for their force; however, that support is clinical in nature and more closely aligns with civilian healthcare offerings typical to each country.

US defense companies are not competitors in what is considered the traditional healthcare business. Defense companies typically do not build hospitals, create new drugs, design or design and sell medical equipment or surgical devices. Even when the US military makes healthcare purchases, they do so by engaging the US healthcare industry experts.

There are compelling reasons why US defense companies do not often, or successfully, engage non-defense/commercial markets. US defense companies sell to what is essentially a single buyer: The US Government. There is no single buyer for any product in any commercial market – monopoly laws keep our markets fair and open. Defense companies are not structured for sales, marketing and distribution on the scale needed to engage a multi buyer commercial market. Doing business with/for the US Government is, by design, neither efficient nor economical, especially when compared to the civilian/commercial marketplace. The safeguards put in place require significant specialized overhead to engage federal opportunities. Further, this overhead is inconsistent the needs of an agile commercial market. Lastly, the majority of defense research and development costs are borne by the US Government. In the commercial sector, the majority of research and development costs are borne by the developer.

Healthcare systems are made up of people with highly specialized clinical skills. They attain and maintained their skills through specialized educational degrees, on the job learning/training, certification and continuing education opportunities.

Healthcare systems, while specialized, are business-minded systems focused to varying degrees on performance, profit/loss, creating and providing value, and delivery of a product to a paying customer. Regardless whether a healthcare system is publicly funded, privately funded, or a combination therein – all healthcare systems are run as a business, and suffer from many of the same challenges complex enterprises suffer from. Helping healthcare systems overcome these challenges is where defense companies can make a real difference.

There are ways for a member of the US defense industry to engage international healthcare markets, however, and these opportunities may, in fact, be easier to execute outside the US than inside.

The challenge is to find those areas of expertise and capability that US defense companies characteristically have that can be matched against the critical needs found throughout international healthcare enterprise systems.

Here are the top US defense industry capabilities and areas of expertise that show the strongest overlap potential with the international healthcare sector:

Overlap Potential	
US Defense Capabilities & Expertise	International Healthcare Sector Areas
Requirements	Needs analysis and gap identification
Individual Team Training	Individual and team education and training
System Integration and interoperability	Integration of disparate mission critical systems
Operations Research	Data analysis and analytics
Security and Enterprise IT	Data system design and deployment

Acknowledging that the US Integrated Defense, Acquisition, Technology and Logistics Life Cycle Management Framework is an amazingly complicated, but entirely necessary environment – there is no implication that US defense companies should envision a similar linked process when engaging the international healthcare sector.
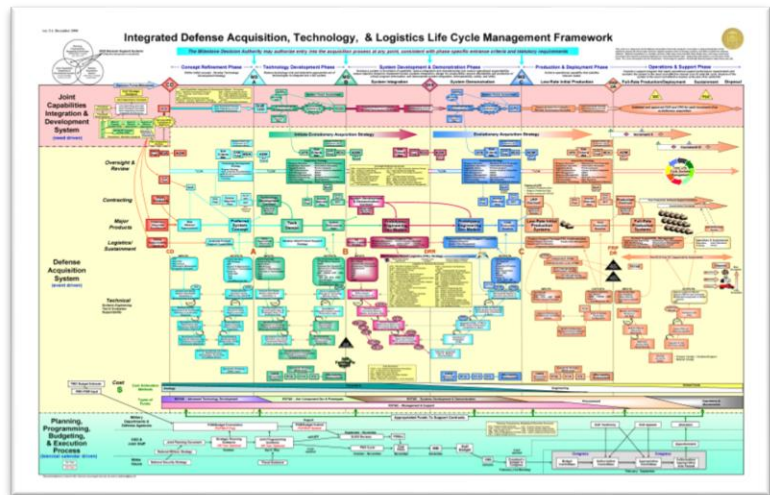
REQUIREMENTS

Identification and determination of US Service and Joint requirements is critical to understanding what the force needs, and the first step in figuring cost. Healthcare systems need help understanding where they have gaps in capabilities and services, need for new capabilities, and how they can best match requirements with resources. This is not a dissimilar need from that solved by service requirements determination processes and the Joint Capabilities Integration and Development System (JCIDS).

INDIVIDUAL AND TEAM TRAINING

The military excels at training unskilled men and women to perform complex, dangerous tasks as both individuals and teams. Internationally, the healthcare education process provides individual men and women with the critical knowledge and skills they need to perform basic caregiving tasks as a licensed practitioner. A subset of these practitioners receives specialized training and education required in areas such as surgery, neurology, internal medicine, and cardiology. Interestingly, because education is an individual endeavor, there is very little opportunity to educate and train teams until they are in a clinical/production environment. There is ample opportunity to create safer healthcare encounters by improving the performance of both individuals and teams. This is especially true when leveraging defense industry expertise in the areas of modeling-and-simulation-based training, dynamic learning, and computer based education.

SYSTEM INTEGRATION AND INTEROPERABILITY (DODAF ETC.)

Healthcare systems across the globe increasingly rely upon the extensive use of electronic medical/health records as well as the collection and exchange of digital health and other data. Unfortunately, managers of these systems have typically purchased and installed their network and data management systems, and the equipment that natively and non-natively resides on them, in piecemeal fashion over decades. Equipment can have varying performance specifications and adhere to different standards-if at

all. US defense companies perform these kinds of system integration and interoperability tasks in accordance with Department of Defense Operational Framework (DODAF) guidelines. As healthcare systems seek to provide greater value and a safer patient experience while reducing costs, finding functional improvements and efficiencies through system integration and interoperability is a prime opportunity for US defense companies.

OPERATIONS RESEARCH

Merriam-Webster describes Operations Research (OR) as the use of scientific and mathematical methods to better study and analyze complex system performance. OR got its start in WWII, where it was developed to help test what eventually became known as RADAR. There is an existing relationship between the field of OR and the "Big Data" problem (and the related lexicon, business analytics, data analysis, and management science). The increasing use of digital tools and networked medical appliances is resulting in a desire and ability to capture more and more data. Turning that data into usable information via OR techniques has the potential to introduce new understandings about patients and systems – understandings that can save patient live and improve patient quality of life. Further, better understanding of how the healthcare system functions – where it is working efficiently, and not – can prove financially valuable. This is an area where US defense companies can and should excel.

SECURITY AND ENTERPRISE IT

In the U.S., the right to keep patient data private is ensured by the Health Insurance Portability and Accountability Act (HIPAA). Most countries have some level of privacy assurance. See the following table.

Country	Personal Data Privacy Protection
Australia	Federal Privacy Act 1988 and Healthcare Identifier Regulations 2010
Canada	Personal Information Protection and Electronic Documents Act (PIPEDA)
South Africa	Protection of Personal Information Act 2013
United Arab Emirates	Article 31 of the UAE Constitution, Article 378 of the Penal Code
United Kingdom	Data Protection Act 1998

Laws and regulations regarding privacy must be backed up with a physical and software infrastructure that reduces accidental breach and thwarts purposeful intrusion and exposure of data. US defense companies have extensive knowledge in data protection. Given the increased exposure of data on disparate networks, there is an increasing opportunity for Virginia defense companies to engage foreign healthcare systems as they work to protect patient data.

EXECUTIVE SUMMARY

The goal of this report is to uncover international healthcare market opportunities with an acceptable cost of entry. Analysis revealed common healthcare and healthcare system trends among the five subject countries.

- » Healthcare costs are rising at unsustainable rates; every country is looking for ways to lower costs, or lower the rate at which costs are rising.
- » Costs and changing demands for healthcare perpetuate a need to adjust the healthcare work-force.
- » Changing demographics, chronic disease, and new health patterns demand significant adjustments to the conduct and provision of healthcare.
- » Consistent, integrated access to healthcare data is an increasing priority and vital to reform.
- » Personalized, predictive approaches to healthcare are needed to improve outcomes and reduce costs.

NEEDS ANALYSIS AND GAP IDENTIFICATION

National level healthcare systems are typically monstrous enterprise level systems. Understanding what is needed and how to acquire or develop the solution is a complicated undertaking – further complicated by the fact that a healthcare system cannot be "turned off" and must remain operable 24/7.

This area of the analysis is focuses on evaluating whether the subject country is in early, ongoing, or late stages of planning system revisions and reforms, and what the potential is for Virginia defense company engagement.

INDIVIDUAL AND TEAM EDUCATION AND TRAINING

The healthcare workforce is made up of physicians, dentists, nurses, pharmacists, and other allied health professionals. These people are educated, receive continuing training (locally and/or abroad), and are able to perform vital care giving and related technical tasks. Most countries require continuing education as a mechanism to stay current, and recertification as a mechanism to ensure competency.

This area of analysis focuses on opportunities for Virginia defense companies to provide enhancements to, or new mechanisms to support existing healthcare education and training in the subject countries.

INTEGRATION AND DISPARATE MISSION CRITICAL SYSTEMS

Healthcare systems tend to be constructed over a number of years. This presents challenges in the areas of system and device interoperability. The desire today to provide remote data collection and observation drives a need for network-capable, secure devices. Newer devices may be natively interoperable; however, older equipment may not be ready to join a network. Add data formats, and the lack of (or changing) data standards, and the cost to integrate systems becomes questionable and/or defeating.

This area of analysis focuses on opportunities for Virginia defense companies to provide system integration and engineering solutions to enterprise healthcare systems. Integration and interoperability of older and newer systems is a consistent requirement for the US Defense Department. The rigor and process used by defense companies to meet customer needs is precisely the level of effort required to generate integrated systems in geographically disperse, unstandardized healthcare systems.

DATA ANALYSIS AND ANALYTICS

The movement to predictive, preventative, personalized medicine (PM) is a worldwide trend. It is a movement away from "one size fits all" to precision, patient-specific treatments that hone in on very specific physiological and genomic differences in patients and their ailments. PM is nothing if not data intensive and data hungry, and requires levels of data analysis and analytics even greater than those seen within highly classified intelligence gathering efforts.

This area of analysis focuses on opportunities for Virginia defense companies to bring unique data analytics and analysis solutions to the subject country healthcare systems.

DATA SYSTEM DESIGN AND DEPLOYMENT

Healthcare data systems typically refer to electronic health or medical record systems, referred to here as EHRs. Even as designed, few (if any) of the EHR systems are interoperable, and sharing data between systems is time consuming and rife with inaccuracies. EHR interoperability is important because patients often have various providers in differing systems. Equally important is the ability to access and share data over geographically diverse and dispersed distances.

This area of analysis focuses on opportunities for Virginia defense companies to provide robust IT and supporting infrastructure to meet the needs of the growing healthcare systems in the subject countries.

REGARDING MODELING AND SIMULATION

Note that modeling and simulation (M&S) technologies and capabilities are not called out as either a defense industry capability/area of expertise or as a healthcare sector overlap area. This is purposeful. While M&S technologies are used extensively in the healthcare sector (both domestically and internationally), the healthcare world does not focus on core technologies like M&S – except as they to meet a need or create a solution. Seldom, if ever, will one find a healthcare budget for M&S.

Areas where M&S technologies and capabilities are most often applied in the healthcare sector include individual and team education and training, and data analysis and analytics. The first closely aligns with the typical use of M&S by the US Department of Defense (DoD) to replicate a learning opportunity. The second more closely aligns with analysis and "big data" problems pursued in DoD test and evaluation, cybersecurity, and research and development projects.

COUNTRY MARKET ANALYSIS

This report is focused on five international healthcare markets: Australia, Canada, South Africa, United Arab Emirates, and the United Kingdom. Analysis of these countries follows.

Figure 1 through Figure 4 provide a comparative view of factors supporting this market analysis:
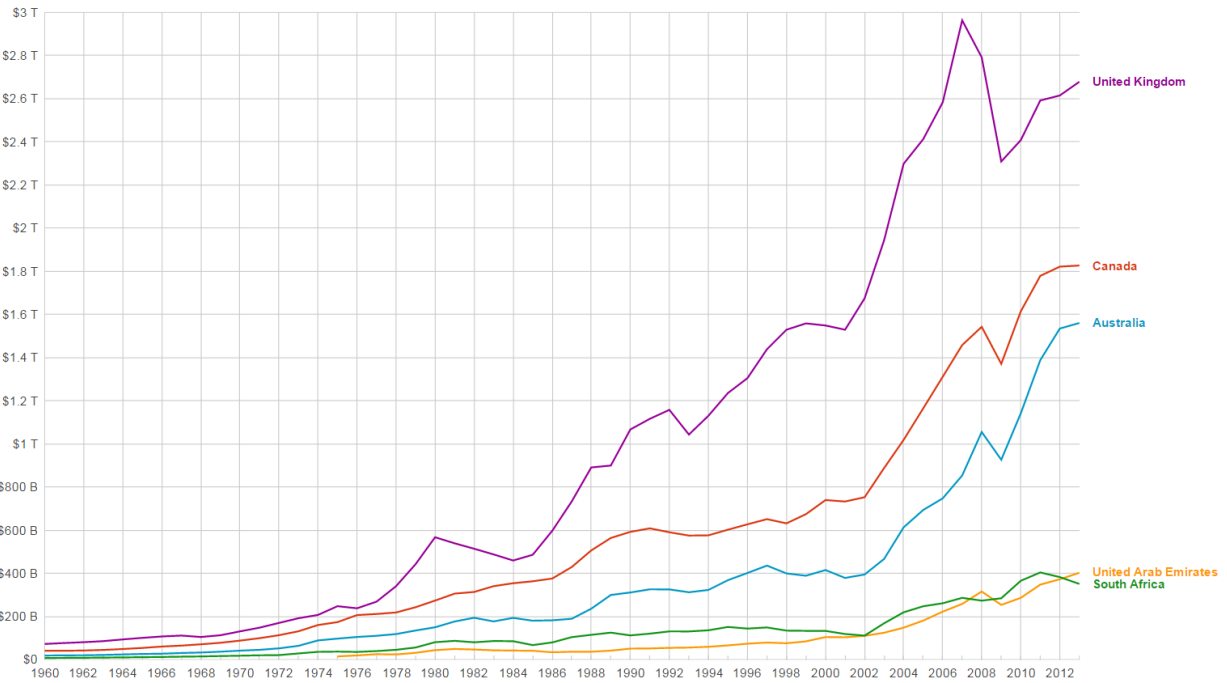
Figure 1: Gross Domestic Product (GDP), in Current $USD. GDP is the monetary value of all the finished goods and services produced within a country's borders in a specific time period, though GDP is usually calculated on an annual basis. Data from the World Bank, last updated January 19, 2015.
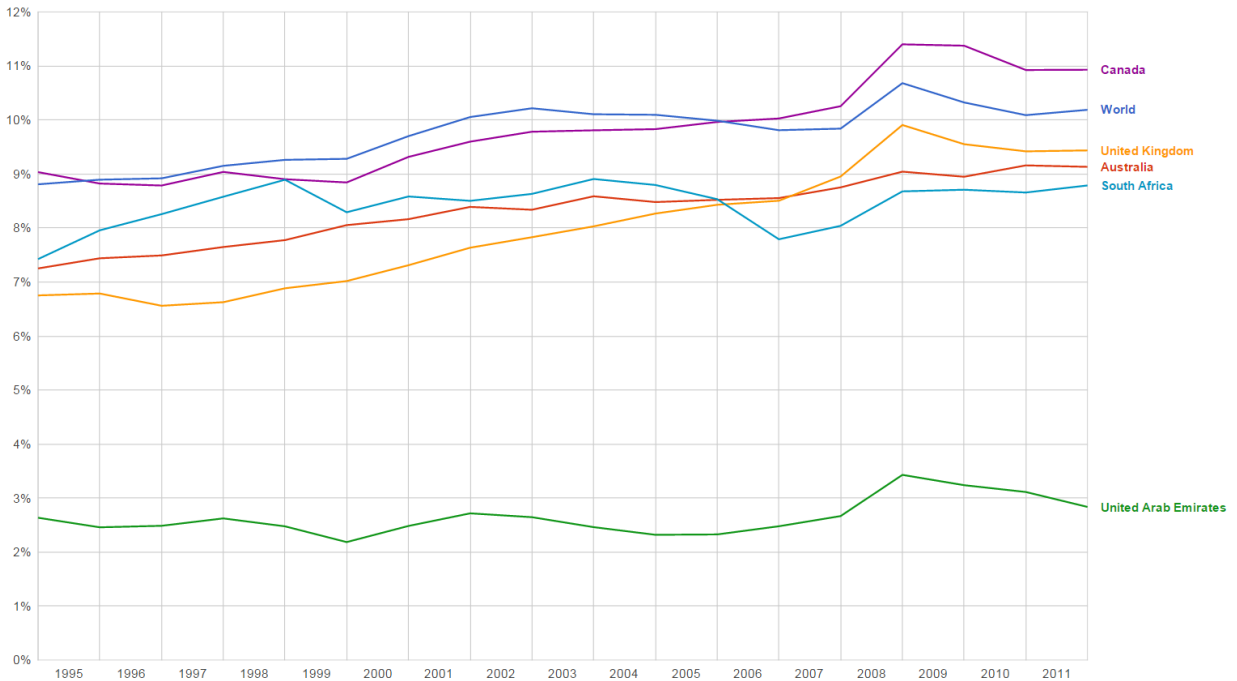
Figure 2: Total (Public & Private) Healthcare Expenditure as Percentage of GDP. Data from the World Bank, last updated January 19, 2015.
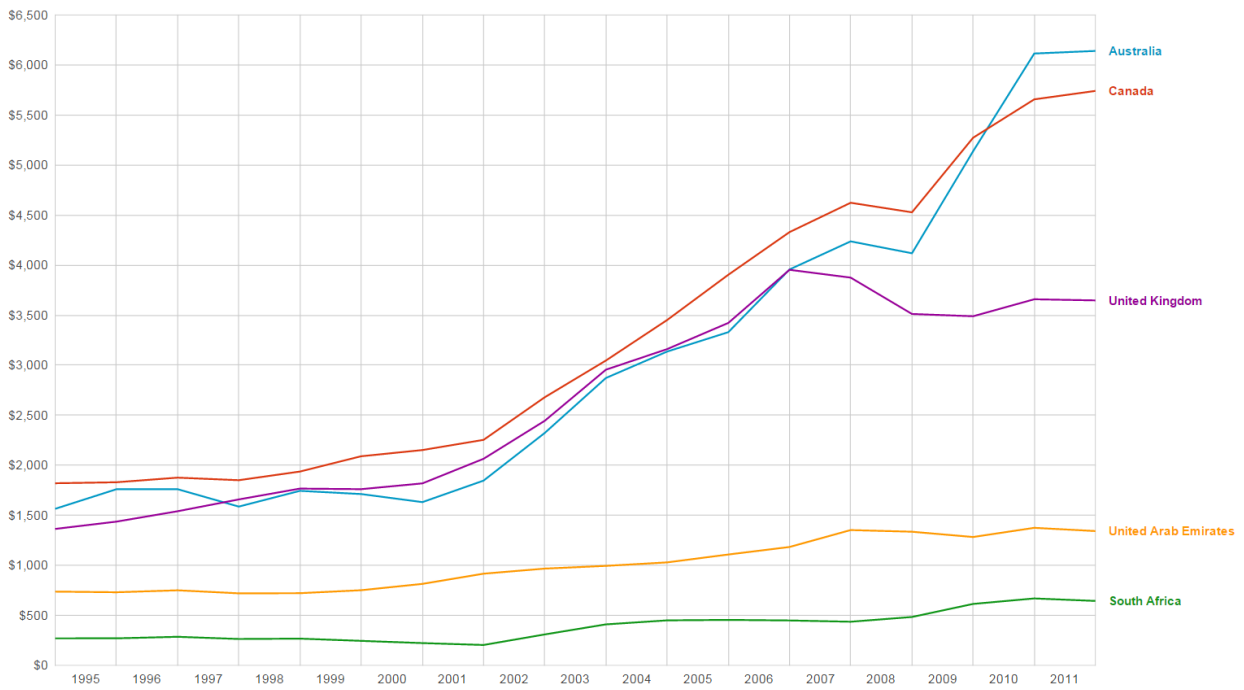
Figure 3: Healthcare Spending Per Capita. Data from the World Bank, last updated January 19, 2015.
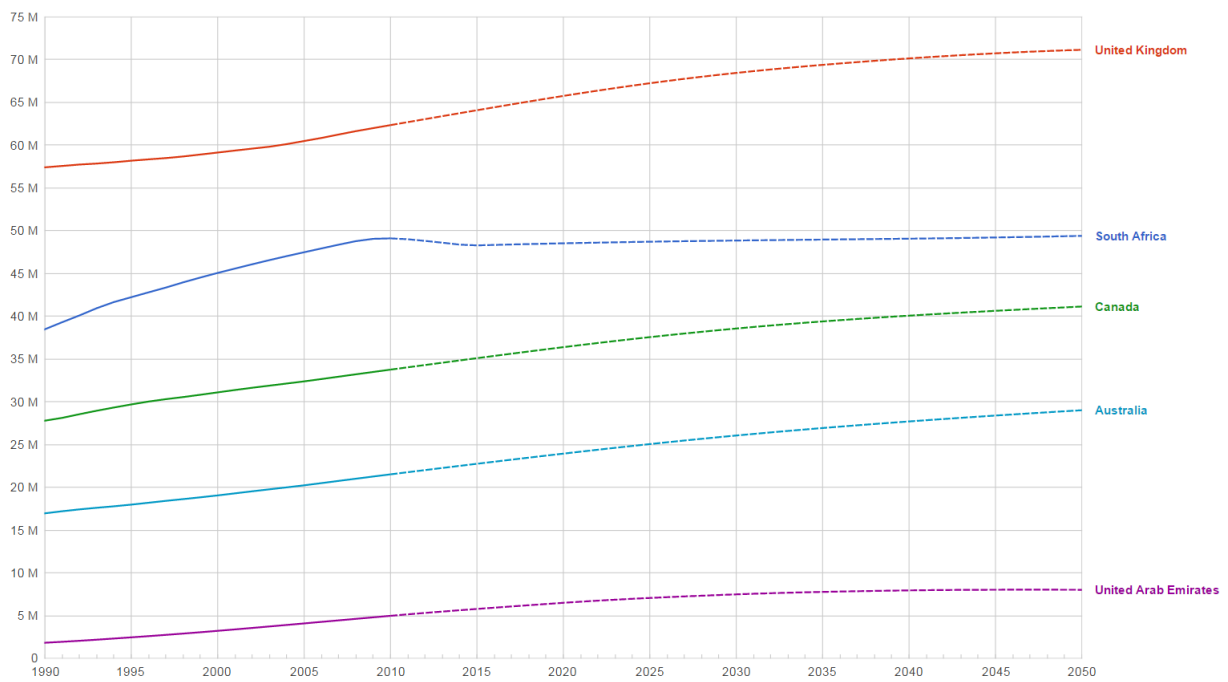
Figure 4: Population (solid line), with Projections (dashed line). Data from US Census Bureau, last updated October 28, 2011.

AUSTRALIA

The Commonwealth of Australia is a constitutional monarchy. Australia was formed in 1901 when the six independent British colonies came together to form a new nation. Australian federal government is made up of the legislative arm (the parliament), the executive arm (led by the Prime Minister), and the judiciary arm (which remains independent of the other two arms).

Population	23.3 million (2013)
Urban population	20.7 million
Country size	2.966 million sq. mi
Median age	37.2
Population growth rate	1.3%
Birth rate	13.3 / 1000
Death rate	6.4 / 1000
Life Expectancy, years	81 (m) / 85 (f)
Literacy rate	99%
GDP (US$ billions)	1,560 (2013)
GDP per capita (US$)	67,458.36
Health expenditures	9.1% of GDP (2012)

There are six states in Australia: New South Wales (NSW – capital: Sydney), Queensland (Qld- capital: Brisbane), South Australia (SA – capital: Adelaide), Tasmania (Tas. – capital: Hobart), Victoria (Vic. – capital: Melbourne) and Western Australia (WA – capital: Perth).

There are 10 Australian territories outside the borders of the states. Two mainland territories, The Australian Capital Territory (ACT) and The Northern Territory (NT) and one offshore territory, Norfolk Island, have been granted a limited right of self-government by the Australian Government. In these territories, a range of governmental matters are now handled by a locally-elected parliament. Outside of government, the ACT and the NT are often treated like states because of their significant population sizes.

Seven territories are governed only by Commonwealth law, usually through an Australian Government-appointed Administrator. They are:

- » Ashmore and Cartier Islands
- » Australian Antarctic Territory
- » Christmas Island
- » Cocos (Keeling) Islands
- » Coral Sea Islands
- » Jervis Bay Territory
- » Territory of Heard Island and McDonald Islands

Australia is considered both a Developed Country and an Advanced Economy by the Central Intelligence Agency and International Monetary Fund, respectively.

The Australian currency is the dollar (symbol: $). One Australian dollar is worth approximately 0.78 US$.

HEALTHCARE IN AUSTRAILIA

The Australian health system has a mix of private and public sector involvement. It aims to give all Australians access to health care at little to no cost. If desired, people may choose healthcare services from the private sector.

The federal government regulates the private healthcare industry. The private healthcare sector includes private healthcare professionals, private hospitals and clinics, non-profit organizations, and the private insurance companies.

The Australian Government has significant financial and policy responsibility for health services including hospitals, public health and mental health. State and territory governments, local governments and non-government organizations are largely responsible for the direct provision of these services, while private practitioners provide most medical, dental and allied health care.

Introduced in 1984, Medicare is Australia's universal public health insurance system. It was designed to provide all Australians with high-quality health care that is both affordable and accessible. Cost for Medicare is tiered relative to what a person can pay. Higher earners contribute more to the system than lower earners. Medicare is largely funded by taxation revenue.

The Australia Department of Health has been especially focused on several initiatives:

- » Population Health
- » Access to pharmaceutical services
- » Access to medical services
- » Aging care and population aging
- » Primary care
- » Rural health
- » Hearing services
- » Indigenous Health
- » Private health (private health insurance)
- » Health System Capacity and Quality
- » Mental Health
- » Health workforce capacity
- » Acute Care
- » Biosecurity and Emergency Response
- » Sport and Recreation

Australia has one of the most efficient and effective health care systems in the world. However, advances in medical technologies and treatments, new pharmaceuticals, the rising incidence of chronic disease in the community and an aging population have meant that healthcare costs continue to rise. Sustainment of the system is the highest priority for the Department of Health.

Australia's public hospitals employed about 275,000 full-time equivalent staff in 2012–13:

- » 45% of staff were nurses
- » 13% were salaried medical officers
- » 14% were diagnostic and allied health professionals
- » Staff growth is approximated 5% for medical officers and 35 for nurses, per year.

Australia's private hospitals employed more than 53,800 full-time equivalent staff in 2011–12:

- » 56% of staff were nurses
- » 2% were salaried medical officers
- » 5% were diagnostic and allied health professionals.

The staffing mix in private hospitals is somewhat different from that in public hospitals, because most medical services are not provided by hospital employees and the range of services provided is different.

HEALTHCARE FINANCING

State and territory governments and the Australian Government provide the majority of funding for the operation of public hospitals. The Australian government funds emergency department and outpatient services.

Most admitted patient services are paid for by private insurance funds. Private hospitals are funded primarily from private insurance and out-of-pocket payments by patients.

Medicare, the universal health insurance program that covers all Australians, is paid for by national and state taxes. Publicly funded pharmaceutical benefits are provided through the Pharmaceutical Benefits Scheme, which subsidizes the cost of a wide range of prescription medicine.

Although Medicare is the basis of Australia's healthcare system and covers many healthcare costs, many Australians take out private health insurance, which provides additional insurance for some services that are not covered by Medicare. Australians can choose to have Medicare only or a combination of Medicare and private health insurance. The Australian Government encourages people to have private health insurance by providing financial incentives to support people's choice to take up and retain private health insurance.

HEALTHCARE DELIVERY

In 2010–11, Medicare Australia paid benefits of $16.4 billion, or $722.98 per person for 319 million items of services, an average of 14.1 services per person.

In 2012–13, there were 746 public hospitals and 592 private hospitals, totaling 1,338 hospitals in Australia. Regarding availability of hospital beds during the same timeframe:

- » Approximately 87,300 beds in public and private hospitals; roughly 3.9 beds for every 1,000 people
- » 65% of hospital beds were in public acute hospitals
- » 30% of beds were in private hospitals

> » The majority of beds were in larger hospitals, located in the more densely populated areas. The largest public hospital had more than 1,000 beds, but over 70% of hospitals had fewer than 50 beds.

DELIVERY REFORM: PAY FOR PERFORMANCE

The 2011 National Health Reform Agreement led to the establishment of activity based funding and management (ABF). Activity Based Funding is a way of funding hospitals whereby they get paid for the number and mix of patients they treat. Individual patient care and treatment issues are taken into account. ABF funding supports timely access to quality health services, improves the value of the public investment in hospital care, and ensures a sustainable and efficient network of public hospital services. Australia is not yet tracking individual patient (or physician/facility) care outcomes as a performance factor.

HEALTHCARE IT

A national level electronic health record system (eHealth) was implemented in July 2012 and is being deployed incrementally. Eventually, having an eHealth record will give healthcare providers access to a patient summary of a patient's key health information, including information such as medications, hospital discharge summaries, allergies and immunizations. This record will be available to providers nationally. Interestingly, eHealth records do not replace existing medical records. Healthcare professionals will continue to take and review clinical notes. Over 1.7 million Australian citizens (7.3% of total population) had created an eHealth record as of June 2014.

The eHealth system exists as a distributed database stored in a network of registered national repositories. Information in the repositories will be held at least 30 years after the date of an individual's death or, if that date is unknown, 130 years after the information was uploaded.

The National eHealth Transition Authority (NEHTA) is leading several national infrastructure projects to support Australia's health reforms. These systems include a standardized procurement system, an authentication service for health record access, eHealth business-to-business gateway services, template services (for semantic interoperability), a National Clinical Terminology and Information Service, and a National Healthcare Service Provider Directory. These projects are in varying degrees of maturity. Australia has also made extensive amounts of healthcare information publically available via the web.

PRECISION MEDICINE

The concept of precision (or personalized) medicine is not foreign to Australians. Organizations such as the Kinghorne Cancer Centre at St. Vincent's Hospital in Sydney focus on patient-specific treatments based upon the ability to measure individual differences at the molecular level.

The National Health and Medical Research Council is focused on collecting genetic information in an effort to support personalized medicine research and utility. A speed bump to growth of precision medicine is how to best express policy regarding its integration into the Australian healthcare system. Managing the vast genomic data alone will require new thinking and approaches for the benefit of policy making, clinical decision making and research. Its value needs to be realized by linking genomic data to other individual and administrative data, greatly increasing the complexity of the task.

HEALTHCARE EDUCATION

Australian Society for Simulation in Healthcare's (ASSH) mission is to promote simulation education, training and research to enhance the safety and quality in healthcare. ASSH represents a cross-section of the Australian healthcare community, including healthcare professionals, academics, industry groups and

policy makers. ASSH operates under the auspices of Simulation Australasia Ltd and is officially affiliated with the international Society for Simulation in Healthcare (SSH). The Australian Medical Council provides medical educational institution accreditation. The Medical Board of Australia provides physician registration. Physician continuing medical education (CME) is managed by medical schools, relies upon physician self-reporting of CME completion, and cycles typically every three to five years.

Australia requires a four-year Bachelor of Science in nursing to practice. Nursing school accreditation is provided via the Australian Nursing and Midwifery Accreditation Council. The Nursing and Midwifery Board of Australia provides nurse registration. There are 12 other Boards that register specialty practitioners.

- » 18 Medical Schools
- » 13 Universities with Nursing Programs
- » 33 Universities with Medical Technology Programs
- » At least 24 Healthcare Simulation Centers
- » 9 Dental Schools

MARKET ACCESS

According to the US Department of State, the US and Australia have a 75-year history of open diplomatic relations and a long history of cooperation in the areas of defense and security; the US-Australia alliance is an anchor for peace and stability in the Asia-Pacific region as well as the world.

Australia is an appealing market. There is no language barrier, and the country possesses a familiar legal and corporate framework, as well as a sophisticated yet straightforward business environment. Cultural differences exist, but are not challenging.

The Australia-United States Free Trade Agreement (AUSFTA) is a long-term commitment and framework to strengthen trade relations and economic integration with the United States across all sectors of the economic relationship. All tariffs will eventually be eliminated, creating significant export opportunities for US companies. Markets for services such as life insurance and express delivery will be opened; intellectual property will be better protected; American investments will be facilitated through predictable access and a stable business environment. For the first time in many sectors, American firms will be allowed to compete for Australia's government purchases on a nondiscriminatory basis. Much of the healthcare oriented aspects of the agreement are focused on pharmaceutical regulation and market access.

OPPORTUNITY AREAS FOR VIRGINIA DEFENSE CONTRACTORS

Australia is the ninth largest export market for U.S. manufacturers of medical products. The country is a mature and competitive market for medical equipment. With more than 95% of its medical products coming from abroad, the Australian medical industry is dependent on imports. The United States is Australia's principal supplier followed by the European Union, Switzerland, and Japan. Due to the demand for the full range of sophisticated medical equipment and the expectation for state-of-the-art medical treatment, there is a continuing need for high quality, innovative medical products. Australia is the third largest export market for US medical products in the Asian Pacific region, behind Japan, and China.

Healthcare imports in high demand within Australia include:

- » Innovative & high quality products
- » State-of-the-art medical technology that can result in a significant improvement in clinical outcomes and reduce healthcare expenditure
- » Products that serve Australia's aging population

Australia is exporting some of their healthcare capability. Areas where Australian demonstrates significant healthcare expertise, and where there is in-country competition for services and products, include:

- » Caregivers and Homecare Services and Products
- » Operators of Aged Care Facilities
- » Experienced Architects and designers in Aged Care
- » Advisory and Consultancy Services
- » Education and Training

The following secondary/tertiary Australian market/product areas show high demand and are attractive, particularly as they overlap into the healthcare market.

- » Mobile application development
- » Innovative Business Intelligence (BI) solutions
- » Data mining tools, fiber optic and copper accelerators, any disruptive technology

The comprehensive Australian Information, Computer and Technology (ICT) market is valued at approximately US$90 billion. The telecommunications market accounts for about $55 billion with IT solutions and services valued at US$35 billion.

NEEDS ANALYSIS AND GAP IDENTIFICATION

Many of Australia's healthcare gaps and needs are in non-clinical care areas, which alleviates the need for clinical expertise.

Each of the following Opportunity Areas benefit from comprehensive needs analysis and gap identification. It is important to note that, the larger the enterprise, the harder it is to determine gaps and express needs with specificity – and specificity is required to predict and control costs.

INDIVIDUAL AND TEAM EDUCATION AND TRAINING

Australia has an extensive educational network across all the states and territories. As with most developed countries, there is a mature ability to educate and train the healthcare workforce. Education services and online training is a hot market in Australia; sophisticated, cutting edge best practices are in high demand, as well. This is an attractive area because Australians are readily looking to the US for best practices.

The use of modeling and simulation to educate and train Australian healthcare professionals is already embedded in institutions of higher learning and, to a lesser degree, in the hospital environment itself. The Australian Society for Simulation in Healthcare, the health division of Simulation Australasia, and The International Society for Simulation in Healthcare promote professional development for individuals and advocates for continued development and availability of simulation-based modalities for education and research. Typical healthcare simulations include standardized patients (role players and assessors) for individual and team training, task trainers, and limited computer-based systems.

Australian healthcare education can benefit from dynamic, adaptive learning systems, delivered via computer/network and tied to learning and performance standards.

Australian healthcare training can benefit from performance measuring trainers to assist in validating and assessing knowledge, procedure, and capability.

INTEGRATION OF DISPARATE MISSION CRITICAL SYSTEMS

The National eHealth Transition Authority (NEHTA) is guiding the development of eHealth systems through nationally defined standards for interoperability. These standards enable eHealth systems to evolve without proprietary limitations.

NEHTA's Compliance, Conformance and Accreditation (CCA) program is responsible for developing a national framework assuring that systems comply with Australian specifications and demonstrate appropriate standards of interoperability, security and clinical safety in the way they handle and exchange information.

Integration and interoperability are understood and appreciated – the HL7 Australia organization (which supports the creation and effective use of e-health standards) and Integrating the Healthcare Enterprise (IHE) Australia (which fills the "gap" between the creation of e-Health standards and their implementation) are good examples of integration and interoperability efforts specific to Australian healthcare.

Nationally, the emphasis is on implementing the new eHealth system and ramping up its capabilities over time. This tactic may help Australia to develop what they need, correctly, the first time; however, it is a time consuming tactic that may not meet the real needs of their users or introduce the real savings and efficiencies for which they are striving.

Information and Computer Technology (ICT) integration planning is taking place at the state level though execution is not immediate.

The Australia Department of Health may be open to taking on a greater role in forcing interoperability standards amongst healthcare systems.

DATA ANALYSIS AND ANALYTICS

According to a 2013 analysis of Australia's healthcare data analytics capability, the country is still immature. Healthcare data must be (1) captured, (2) shared, (3) understood, and finally (4) acted upon. Australia is still in data capture mode. This is evidenced by the recent and incomplete adoption of eHealth, which is a fundamental patient centered data collection point. Most data analysis and analytics efforts are isolated and not implemented at the National level. Healthcare organizations are focused primarily on improving care and access via the old models; this may be due to a lack of understanding and funding. A lack of interoperability between existing digital systems is another barrier to success.

Australia wants to shift its model from a point-of-care service delivery focus to patient-centric, accountable health management. This cannot be done without the development of a specialized healthcare informatics/data analysis/analytics capability throughout the country.

The lack of maturity in the Australian data analysis and analytics capability denotes a tremendous opportunity for Virginia defense companies. Areas (2), (3) and (4) mentioned previously in this section are relatively untouched, at this point.

Organizations need analytics capabilities that can grow as their data systems begin to capture and share more data. There is a hunger for this capability, but no clear path forward.

Data storage will inevitably become a growth area as this need increases over time.

IT AND DATA SYSTEM DESIGN AND DEPLOYMENT

Within the Australian healthcare system, managers and practitioners feel that healthcare information technology (HIT) is a major impediment to both clinical and business best practice, and responsible for the poor delivery of care, high costs, and limited customer service. Further, the current implementation of HIT systems is focused on reducing risk and supporting processes (business needs), and not on delivery of care and outcomes (patient needs). Normally, clinical information is shared via email, not an integrated, purposeful system.

Areas that appear to be in good shape include personal healthcare information security/confidentiality, maintenance of equipment, and state-wide enterprise systems.

There is a need for the design and implementation of HIT systems, integrating and evolving existing capabilities that are focused primarily on delivery of care and patient outcomes and secondarily on supporting business processes.

Further – considering that HIT is a subset of the Australian Information and Communications Technology market – according to a 2013 Export.gov analysis:

> *The Australian Information and Communications Technology (ICT) market is valued at approximately US$85 billion. The information technology (IT) services industry accounts for approximately 33% of the total IT market and is valued at nearly US$11.4 billion. The Australian Federal Government is the largest public sector user of IT services. Key clients include: Department of Defense, Australian Taxation Office, Centrelink, Veterans Affairs, Australian Customs, Medicare, and the Department of Human Services.*

OPPORTUNITY OVERLAP SYNOPSIS

Based upon research and analysis performed for this report, the subjective opportunity for Virginia defense companies in the below areas can be evaluated as Low, Medium, or High.

These are subjective assessments based upon a number of factors particular to each healthcare sector area, including but not limited to:

» Identification of gaps, needs, and shortcomings relevant to the healthcare sector area
» Plan to address gaps, needs, and shortcomings
» Progress made addressing gaps, needs, and shortcomings
» Relative match of general defense capability to identified gaps, needs, and shortcomings

Overlap Potential		
U.S. Defense Industry Capabilities & Expertise	*International Healthcare Sector Areas*	*Australia Opportunity*
Requirements Capture & Analysis	Needs analysis and gap identification	Medium
Individual & Team Training	Individual and team education and training	Medium
System Integration and Interoperability	Integration of disparate mission critical systems	High
Operations Research	Data analysis and analytics	High
Security & Enterprise IT	Data system design and deployment	Medium

A Low characterization reflects a challenging market opportunity.

A Medium characterization reflects a market opportunity with strong potential.

A High characterization reflects a market opportunity that is a good fit for Virginia defense companies.

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CANADA

Canada became a self-governing dominion in 1867 while retaining ties to the British crown. The government, based in Ottawa, is a democratic constitutional monarchy, with a Sovereign as head of State and an elected Prime Minister as head of Government. Queen Elizabeth II is the Sovereign Leader of the Commonwealth and Canada's formal Head of State, and head of both the executive and legislative branches.

Population	35.6 million (2014)
Urban population	80.4%
Country size	3,855,100 sq mi
Median age	40.1
Population growth rate	1%
Birth rate	11.2 per 1000
Death rate	7.1 per 1000
Life Expectancy, years	79 (m) / 83 (f)
Literacy rate	99%
GDP (US$ billions)	$1,827
GDP per capita (US$)	51,958.40
Health expenditures	10.9% of GDP (2012)

Canada has 10 provinces and three territories, each with its own capital city. The provinces and territories are grouped into five regions:

- » **Atlantic Provinces**: Newfoundland and Labrador, Prince Edward Island, Nova Scotia and New Brunswick
- » **Central Canada**: Quebec and Ontario
- » **Prairie Provinces**: Manitoba, Saskatchewan and Alberta
- » **West Coast**: British Columbia
- » **North**: Nunavut, Northwest Territories and Yukon Territory

Most people live in southern Ontario and Quebec, southwest British Columbia and Alberta. Much of the north has a very low population because of the cold climate. Canada has two official languages: English and French, although English is most prevalent.

Canada is considered both a Developed Country and an Advanced Economy by the Central Intelligence Agency and International Monetary Fund, respectively.

Canadian currency is the Canadian Dollar. One USD is approximately equivalent to 1.25 dollars, Canadian.

HEALTHCARE IN CANADA

Canada has a publicly funded and controlled healthcare system. Healthcare in Canada is comprehensive, and insures all health services except for workers compensation. The system has evolved over the past 40 years and will continue to change to meet the demands of the population and general advances in care. The modern system meets national principals established under 1984's Canada Health Act, which

provides for public administration of the system, comprehensive services, universal care, accessible care, and portability of care and records throughout the country.

The federal department Health Canada administers and funds the healthcare system. The healthcare system is the domain of the provinces and territories. The Canada Health Act of 1984 created a minimum standard for insurance plans, creating 13 public single-payer insurance mechanisms that are distinct, but similar.

Quick and easy access to ongoing care is difficult for temporary visitors, as most physicians will not take on new patients. Specialist care is by referral and the wait times for appointments can be months. US healthcare insurance is not accepted anywhere in Canada. Canadian Medicare insurance does not extend outside of the country. Physicians are funded directly by their respective province.

Cost drivers of Canadian healthcare are changes in population size and health, aging, income and inflation, and health technological innovation costs.

HEALTHCARE FINANCING

Canadian basic healthcare is funded through taxes. Private health insurance can be purchased to pay for things the government does not fully cover, such as pharmaceuticals, dental care, physiotherapy, ambulance services, and eyeglasses.

According to the Canadian Institute for Health Information (CIHI), in 1975, total Canadian health care costs consumed 7% of the Gross Domestic Product (GDP). Canada's total health care expenditures as a percentage of GDP grew to an estimated 11.7% in 2010 (or $5,614 CDN per person). In 2010, publicly funded health expenditures accounted for seven out of every 10 dollars spent on health care. The remaining three out of every 10 dollars came from private sources and covered the costs of supplementary services such as drugs, dental care and vision care.

Each province and territory has its own health insurance plan; while similar, coverage differs. These plans pay roughly 70% of the Canadian healthcare bill. Coverage differs for many essential health goods and services such as pharmaceuticals, medical devices, and outpatient services such as eye care, dental care, physiotherapy, and home care.

HEALTHCARE DELIVERY

Canada's publicly funded health care system is a coordinated set of 10 provincial and three territorial health systems. Known to Canadians as "Medicare," the system provides access to a broad range of health services.

Care is delivered through Primary Healthcare Services (primary care doctors and clinics), Secondary services (specialized care at a hospital, long term care facility, or within the community), and, if needed, supplementary services (those not normally covered, focused on specific people/populations).

Canada is home to more than 630 hospitals, and over approximately 73,500 hospital beds.

DELIVERY REFORM: PAY FOR PERFORMANCE

Canada is considering pay for performance to add quality improvement incentives into their system; however, planning and considerations regarding implementation are ongoing.

HEALTHCARE IT

The Canadian Institute for Competitiveness and Prosperity concluded that the systemic under-investment in IT is a major reason why Canada's GDP per capita is nearly $10,000 less than that of the US.

The healthcare IT infrastructure is not set up to capture and track the massive amounts of data required to meet the capabilities of the data-capable devices entering the market. Further, it is not capable of supporting the data-hungry analytical requirements of personalized medicine.

Canada Health Infoway is a federally funded not for profit that is working to establish a network of interoperable electronic health records (EHR) solutions in Canada. This organization has developed an EHR Blueprint that provides an enterprise systems/IT architecture view of sponsored projects being developed incrementally within the system.

PRECISION AND PERSONALIZED MEDICINE

Canada is investing in personalized medicine research, but progress has been slow. The Canadian Institutes of Health Research has initiated a Personalized Medicine Signature Initiative with a goal to enhance health outcomes through patient stratification approaches by integrating evidence-based medicine and precision diagnostics into clinical practice. To date, over $200 million (CAND) has been invested or committed by CIHR and its partners over a 5-year period to support personalized medicine research across Canada.

There are five components requiring focus and investment for a national personalized medicine framework in Canada:

- » Building evidence (planned investment: $200 million CD)
- » Addressing regulatory and policy challenges
- » National infrastructure and services (Biobanks, info portals, cohorts, innovation centers)
- » Data handling (harmonization of 'omics, imaging, and environmental/lifestyle data)
- » Outreach and education (Coordination with other CIHR initiatives)

Big data analytics has been slow to develop in Canadian healthcare. Activity is largely on the periphery of health care (i.e., research studies) and not yet in mainstream practice. There is a hesitance to adopt data analytics because the benefits are not yet proven or well documented. Privacy and security are important considerations affecting the pace of adoption, as well. Lastly, Canada tends to lag other countries in the adoption of newer technologies.

HEALTHCARE EDUCATION

The Association of Faculties of Medicine of Canada (AFMC) represents Canada's 17 medical schools and is the voice of academic medicine in the country. Canada graduates over 2,300 MDs a year. The medical education system includes over 10,000 undergraduate medical students in training and more than 12,000 postgraduate trainees. The number of students entering MD programs increased 73% between 1995 and 2009. The medical schools employ over 21,000 full and part-time faculty.

While parent universities and satellite campuses are the main learning locations during the first half of the MD program, students spend most of their third and fourth years off campus, in clinical teaching facilities. There were more than 900 clinical teaching facilities affiliated with schools of medicine in 2009-10.

The Canadian Association of Schools of Nursing (CASN) is the national voice for nursing education, research, and scholarship and represents baccalaureate and graduate nursing programs in Canada. The

CASN National Nursing Education Framework outlines Guiding Principles and Essential Components for Undergraduate and Master's Nursing Education. Doctoral guidelines are in development.

The Canadian Healthcare Education Commons provides an online workspace for groups to collaborate.

- » 17 Medical Schools
- » 95 Schools and Universities with Nursing Programs
- » 100+ Universities with Medical Technology Programs
- » At least 15 Healthcare Simulation Centers
- » 11 Dental Schools

MARKET ACCESS

According to the US Department of State:

The United States and Canada share two borders and their bilateral relationship is one of the closest and most extensive in the world. It is reflected in the high volume of bilateral trade--more than $2 billion a day in goods and services--and in people-to-people contact. About 300,000 people cross between the countries every day by all modes of transport. In fields ranging from security and law enforcement to environmental protection to free trade, the two countries work closely together on multiple levels, from federal to local.

The United States and Canada share the world's largest and most comprehensive trading relationship, which supports millions of jobs in each country. Canada is the single largest foreign supplier of energy to the United States. Canada is the third largest holder of oil reserves after Saudi Arabia and Venezuela and is the only non-OPEC member in the top five. Canada and the United States operate an integrated electricity grid under jointly developed reliability standards. Uranium mined in Canada helps fuel U.S. nuclear power plants.

The North American Free Trade Agreement (NAFTA) among the United States, Canada, and Mexico has reduced trade barriers and established agreed upon trade rules.

Medical device manufacturers must develop partnerships with Canadian distributors to sell their products. This requires companies to obtain an establishment license and, if necessary, a device license. Imported medical devices are subject to Canadian safety and effectiveness regulations and packaging requirements. Few other barriers exist for US businesses looking to sell in Canada.

Health Canada is an equivalent regulatory agency to the U.S. Food and Drug Administration (FDA).

OPPORTUNITY AREAS FOR VIRGINIA DEFENSE CONTRACTORS

Hospitals and public health institutions are the purchasers of medical equipment and supplies, usually buying direct from manufacturers for capital equipment and using group procurement and distribution for regular medical equipment. There is a need for diagnostic equipment (visualization and diagnosis), consumables, prosthetic equipment, and dental products.

Key Canadian Healthcare system issues:

- » There is an over reliance on hospital-based care,
- » Access to care is neither geographically nor capably equitable
- » Incentives are not well coordinated and misaligned across the system

- » Drug payment policies are inconsistent,
- » The system is fragmented, and
- » There is poor accountability for quality and effectiveness.

NEEDS ANALYSIS AND GAP IDENTIFICATION

Many Canadian healthcare system gaps and needs are in non-clinical care areas, which alleviates the need for clinical expertise.

Each of the following Opportunity Areas benefit from comprehensive needs analysis and gap identification. It is important to note that, the larger the enterprise, the harder it is to determine gaps and express needs with specificity – and specificity is required to predict and control costs.

INDIVIDUAL AND TEAM EDUCATION AND TRAINING

Medical and nursing schools incorporate training in health IT technologies; however, gaps exist in continuing professional development training and education opportunities, where these credentialed workers need training update and refresher opportunities as well as introduction to new technologies. It is important to expand the opportunities for clinical professionals to acquire clinical informatics and health information management skills throughout their careers.

Projected demands for health informatics management professionals in Canada will increase over the next five years; this increase need is driven by growth and replacement demands. Shortages of these skilled professionals put the Canadian healthcare system at risk.

Health IT priorities are driving workforce changes. There is a projected increase in the demand for workers focused on support, utilization, and optimization of health IT.

The use of simulation to support healthcare education and training is widespread in Canada. There are opportunities to expand and integrate the way simulation is employed, particularly in the areas of skill/task objective capabilities measurement against performance standards – standards that are not universally established.

INTEGRATION OF DISPARATE MISSION CRITICAL SYSTEMS

Canada has a need to integrate over 40,000 existing health IT systems while also adding new and enhanced systems into the care system. Every province and territory is collaborating and approximately $4 billion CD has been allocated to the development of solutions.

Canada Health Infoway has also established several ImagineNation Challenges (with monetary reward) that seek to inspire and spread innovation in health and health care.

DATA ANALYSIS AND ANALYTICS

For the past decade, the Canadian data analytics industry has been focused on digitizing points of service and on the interoperable EHR. Data analytics has been a secondary or tertiary concern; however, there is a growing understanding that data analytics technology can improve operational efficiency and drive innovation. Canada is late to develop this capability.

In Canada, as elsewhere, big data projects require an acceptable business model, governance, leadership, skilled workforce, best practices, privacy and security, ethics, and a highly reliable infrastructure.

Organizations need support for analysis that explains how important an organization's data is, and emphasize the need for an analytical orientation for decision-making. Leaders need to understand that data is a competitive differentiator and not just a need for more storage space.

Canada will likely see incremental adoption of healthcare data analytics. Key areas include cancer treatment and genomics; clinical decision support; data access, sharing, and monitoring; and predictive analytics.

DATA SYSTEM DESIGN AND DEPLOYMENT

New health IT investments will continue in each province/territory as new technologies are extended into other areas of the healthcare sector, such as long-term care and public health. Legacy systems will continue to be upgraded, as well.

According to The Conference Board of Canada, Canada's ranks 8th out of 15 peer countries on information and communications technology (ICT) investment, measured as a percentage of non-residential gross fixed capital formation. This earns Canada a "D" grade. Note that the US received a grade of "A." Canada's ICT investment in 2010 was 17% of non-residential gross fixed capital formation, slightly lower than the 15-country average rate of 18.5 %.

OPPORTUNITY OVERLAP SYNOPSIS

Based upon research and analysis performed for this report, the subjective opportunity for Virginia defense companies in the below areas can be evaluated as Low, Medium, or High.

Again, these are subjective assessments based upon a number of factors particular to each healthcare sector area, including but not limited to:

> » Identification of gaps, needs, and shortcomings relevant to the healthcare sector area
> » Plan to address gaps, needs, and shortcomings
> » Progress made addressing gaps, needs, and shortcomings
> » Relative match of general defense capability to identified gaps, needs, and shortcomings

A Low characterization reflects a challenging market opportunity.

A Medium characterization reflects a market opportunity with strong potential.

A High characterization reflects a market opportunity that is a good fit for Virginia defense companies.

Overlap Potential		
U.S. Defense Industry Capabilities & Expertise	*International Healthcare Sector Areas*	*Canada Opportunity*
Requirements Capture & Analysis	Needs analysis and gap identification	Medium
Individual & Team Training	Individual and team education and training	Medium
System Integration and Interoperability	Integration of disparate mission critical systems	High
Operations Research	Data analysis and analytics	High
Security & Enterprise IT	Data system design and deployment	Medium

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REPUBLIC OF SOUTH AFRICA

The Republic of South Africa (common name: South Africa) is a constitutional democracy with a three-tier system of government similar to the United Stated. The democracy is protected by a progressive constitution that includes an impressive Bill of Rights. Citizens are guaranteed the right to healthcare and vibrant civil society.

South Africa is made up of nine provinces: Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West, and Western Cape.

South Africa's currency is the Rand. One Rand (R) is equivalent to 0.086 USD; one USD is equal to 11.68 Rand (Feb 2015).

Population	52.8 million (2013)
Urban population	33.7 million
Country size	470,693 sq mi
Median age	26
Population growth rate	-0.48% (est 2014)
Birth rate	18.94 per 1000
Death rate	17.49 per 1000
Life expectancy, years	56 (m) / 62 (f)
Literacy rate	89%
GDP (US$ billions)	$351 (2013)
GDP per capita (US$)	6,618 (2013)
Health expenditures	8.8% of GDP

Unemployment in South Africa is typically 25%. Ten percent of the population earns 45% of the national income.

South Africa is considered a Developed Country by the Central Intelligence Agency. The International Monetary Fund does not consider it an advanced economy.

HEALTHCARE IN SOUTH AFRICA

South Africa has a dual healthcare system, with a public health-care sector that operates in parallel with privately funded healthcare provision. In the 2013/14 financial year, health sector expenditure in South Africa made up 8.8% of Gross Domestic Product (GDP). Half of that expenditure was in the private sector. Despite this funding, South Africa's health outcomes fall below the quality standards achieved in comparable upper-middle-income countries, and the country's healthcare system has been described as being both inequitable and inefficient.

The National Department of Health is responsible for national health policy. Nine provincial departments of health are responsible for developing provincial policy within the framework of national policy and public health service delivery.

The private health system consists of general practitioners and private hospitals, with care in the private hospitals mostly funded through medical schemes. In 2008, 70% of private hospitals lay in three of the country's nine provinces, with 38% located in Gauteng province (Johannesburg and Pretoria) alone.

Note that 17% of the world's AIDS/HIV cases globally are found in South Africa (which is home to 0.7% of the global population).

TEN BIGGEST CHALLENGES FACING THE SOUTH AFRICA HEALTH SECTOR, 2010-2015

Prevention and control of epidemics

1. Prevention and treatment of HIV/AIDS
2. Prevention of new epidemics (esp. MDR-TB)
3. Prevention of alcohol abuse

Allocation of resources

4. Distribution of financing & spending
5. Availability of health personnel in the public sector

Health systems management

6. Quality of care
7. Operational efficiency
8. Devolution of authority
9. Health worker morale
10. Leadership & innovation

Six areas of critical concern to patients, covering a sub-set of the full standards, have been identified as non-negotiable priorities, as follows:

» Values and attitudes of staff, so that patients are treated in a respectful manner with due respect for privacy and choice (domain: patient rights).

» Reducing waiting times and queues for administration, assessment, diagnosis, pharmacy, surgery and referral and transfer time (domain: patient rights).

» Cleanliness of hospitals and clinics, including buildings, grounds, amenities, equipment and staff (domain: patient rights).

» Keeping patients safe and providing reliable care by reducing adverse events resulting from care given, including operations and failures of the system and its workers through ignorance, inadequate inputs, systems failure or negligence (domain: patient safety, clinical governance and care).

» Preventing infections from being passed on in hospitals and clinics, specifically hospital-acquired infections (domain: patient safety, clinical governance and care).

» Ensuring that medicines, supplies and equipment are available and that patients get their prescribed medicine on the same day (domain: clinical support services).

The South Africa National Core Standards (NCS) were developed to provide benchmark for and consistency of care. The NCS are structured into seven crosscutting domains to reflect a systems approach, and define the scope or intent of assessing a health area where quality or safety might be at risk.

South Africa National Core Standards Domains	Sub-domains
Domain 1: Patient Rights The domain of Patient Rights sets out what a hospital or clinic must do to make sure that patients are respected and their rights upheld, including getting access to needed care and to respectful, informed and dignified attention in an acceptable and hygienic environment, seen from the point of view of the patient, in accordance with Batho Pele principles and the Patient Rights Charter.	» Respect and dignity » Information to patients » Physical access » Continuity of care » Reducing delays in care » Emergency care » Access to package of services » Complaints management
Domain 2: Patient Safety, Clinical Governance and Care The Patient Safety, Clinical Governance and Care domain covers how to ensure quality nursing and clinical care and ethical practice; reduce unintended harm to healthcare users or patients in identified cases of greater clinical risk; prevent or manage problems or adverse events, including health care associated infections; and support any affected patients or staff.	» Patient care » Clinical management for improved health outcomes » Clinical leadership » Clinical risk » Adverse events » Infection prevention and control
Domain 3: Clinical Support Services The Clinical Support Services domain covers specific services essential in the provision of clinical care and includes the timely availability of medicines and efficient provision of diagnostic, therapeutic and other clinical support services and necessary medical technology, as well as systems to monitor the efficiency of care provided to patients.	» Pharmaceutical services » Diagnostic services » Therapeutic and support services » Health technology services » Sterilization services » Mortuary services » Efficiency management
Domain 4: Public Health The Public Health domain covers how health facilities should work with non-governmental organizations and other healthcare providers along with local communities and relevant sectors, to promote health, prevent illness and reduce further complications; and ensure that integrated and quality care is provided for their whole community, including during disasters.	» Population service planning and delivery » Health promotion and disease prevention » Disaster preparedness » Environment control
Domain 5: Leadership and Corporate Governance The Leadership and Governance domain covers the strategic direction provided by senior management, through proactive leadership, planning and risk management, supported by the hospital board, clinic committee as well the relevant supervisory support structures and includes the strategic functions of communication and quality improvement.	» Oversight and accountability » Strategic management » Risk management » Quality management » Effective leadership » Communications and public relations
Domain 6: Operational Management The Operational Management domain covers the day-to-day responsibilities involved in supporting and ensuring delivery of safe and effective patient care, including management of human resources, finances, assets and consumables, and of information and records.	» Human resource management and development » Employee wellness » Financial resource management » Supply chain management » Transport and fleet management » Information management » Medical records

Domain 7: Facilities and Infrastructure The Facilities and Infrastructure domain covers the requirements for clean, safe and secure physical infrastructure (buildings, plant and machinery, equipment) and functional, well-managed hotel services, and effective waste disposal.	» Buildings and grounds » Machinery and utilities » Safety and security » Hygiene and cleanliness » Linen and laundry » Food services

HEALTHCARE FINANCING

National Health Insurance (NHI), piloted in 2012, is the central means by which the government aims to achieve universal health coverage, under the principles of social solidarity and equity elaborated in the National Development Plan. South Africa has been exploring the concept of NHI since 2002. To implement NHI, the government is changing the way that health services are financed, ensuring the provision of primary care, improving access to a qualified healthcare workforce, and ensuring the availability of qualified medical products.

South Africa's healthcare expenditure in 2013 was estimated at R302 billion, almost 9% of the GDP, and is considered to be the highest in Africa. Of that amount, 50% is spent on the public sector. Public expenditure will grow as NHI is implemented.

HEALTHCARE DELIVERY

South Africa is an emerging global health leader. A unique combination of factors in South Africa – including a high disease burden, strong academic and intellectual resources, government funding to research and development, private sector investments, and an active civil society – has led to program innovations and leadership in global health. South Africa's response to major health challenges since 2009 has been notable in terms of innovation and leadership, particularly in expanding HIV and tuberculosis treatment and care. Early adoption of new tools, policies, and approaches has had a great influence on other countries' policy decisions, particularly in Southern Africa.

South Africa has 4,200 public health facilities. The primary health-care system includes district hospitals and community health centers/clinics.

HEALTHCARE IT

South Africa desires to implement an eHealth capability, providing electronic health records, routine health management information, vital registration, consumer health informatics, health knowledge management, mobile health (mHealth), telemedicine, virtual healthcare, and health data analytics. Specifics are outlined in the 2012 document "National eHealth Strategy." To meet this objective, South Africa will move incrementally, building upon existing capabilities and implementing new solutions when necessary. Infrastructure, connectivity, basic information computer technology (ICT) literacy, educated workforce, and affordability planning are critical to this effort.

PRECISION MEDICINE

There is a desire throughout the South Africa healthcare system to incorporate and capitalize on precision and personalized medicine capabilities and technologies. Research entities exist, but adoption within the healthcare system is slow. This is attributed to the overall cost to develop and employ this capability.

The South African National Bioinformatics Institute delivers biomedical discovery appropriate to both international and African context. SANBI's first major scientific breakthrough was in collaboration with US investigators and resulted in the discovery of genetic cause for a type of blindness in humans called

retinitis pigmentosa. SANBI became the bioinformatics research center for the Center for AIDS Program in South Africa in 2003, and is now integral to HIV research in vaccine development.

The African Society of Human Genetics is a forum used meet, interact, network and collaborate. The Society's aim is to equip the African scientific community and policymakers with the information and practical knowledge they need to contribute to the field of genetics research and to attract global attention to the efforts of African scientists.

South Africa is hosting the First Annual African Symposium on Genome-wide association studies for complex disease April 23rd - 24th, 2015. This conference brings an interdisciplinary group of scientists together to discuss designing and performing gene-mapping studies in the African Continent.

HEALTHCARE EDUCATION

As of 2012, over 165,000 qualified health practitioners in both public and private sectors were registered with the Health Professions Council of South Africa. Of this number, there were registered over 38,000 physicians and over 5,500 dentists.

The doctor-to-population ratio is estimated to be 0.77 per 1,000. Since over 70% of general practitioners are in the private healthcare sector, there is just one publicly funded physician per roughly 4,200 people. Student enrollment in medical school increased by 34% between 2000 and 2012.

Approximately 1,200 medical students graduate annually. In some communities, medical students provide health care to clinical patients under supervision. To help address the tremendous need for public sector care, newly graduating doctors and pharmacists complete a year of compulsory community service in understaffed hospitals and clinics. Another mechanism to promote healthcare availability is the introduction of clinical health associates (midlevel health-care providers) to work in underserved rural areas.

At the end of 2013, there were more than 129,000 registered nurses, and over 120,000 enrolled and auxiliary nurses in South Africa. There were over 30,000 in the nurse-training pipeline. This equates to roughly one nurse per 200 South Africans.

Major challenges facing the nursing profession, identified in a 2011 Department of health nursing summit, can be grouped thusly:

- » Nursing education and training;
- » Resources in nursing;
- » Professional ethos and ethics;
- » Governance, leadership, legislation and policy;
- » Positive practice environments;
- » Compensation, benefits and conditions of employment; and
- » Nursing human resources for health.

In total, South Africa consists of:

- » 8 Medical Schools
- » 251 accredited nursing education institutions
- » 12 Universities with Medical Technology Programs
- » No less than 2 Healthcare Simulation Centers
- » 6 Dental Schools

MARKET ACCESS

South Africa has the largest health care market in Africa, estimated to be worth approximately $31.5 billion USD at the end of 2013; pharmaceuticals account for less than 10% of the market. The government is the largest purchaser of healthcare and education services/products. Purchases are made through competitive bidding, with opportunities available via the State Tender Bulletin.

South African protective tariffs can be a barrier to trade in South Africa. Other barriers include technical standards, import permits, an inefficient bureaucracy, and excessive regulation.

According to the Office of the US Trade Representative, the US and South Africa signed a Trade and Investment Framework Agreement (TIFA) in 2012. In addition, the US and the Southern Africa Customs Union (SACU), which includes South Africa, signed a Trade, Investment, and Development Cooperative Agreement (TIDCA) in 2008. The TIDCA establishes a forum for consultative discussions, cooperative work, and possible agreements on a wide range of trade issues, with a special focus on customs and trade facilitation, technical barriers to trade, sanitary and phytosanitary measures, and trade and investment promotion.

US companies entering the South African market must contend with a typically mature and competitive market with well-established European and Asian competition. A trade agreement with the European Union (EU) enables many EU products to enter South Africa duty-free or at lower rates than US products.

US products are generally highly regarded. The best opportunities for US export are for capital goods; however, infrastructure/construction, medical equipment and healthcare services, telecommunications and information technology remain high prospects for US companies.

OPPORTUNITY AREAS FOR VIRGINIA DEFENSE CONTRACTORS

Generally, South Africa has the necessary policies and resources to improve human resource indicators. However, it lacks the implementation capacity to translate these policies into broad-based results.

According to the South Africa National Development Plan, by 2030 South Africa should have:

1. Raised the life expectancy to at least 70;
2. Progressively improved TB prevention and cure;
3. Reduced maternal, infant and child mortality;
4. Significantly reduces prevalence of non-communicable diseases;
5. Reduced injury, accidents and violence by 50% from 2010 levels;
6. Completed health system reforms;
7. Ensured primary healthcare teams provide care to families and communities;
8. Provide universal healthcare coverage, and;
9. Filled posts with skilled, committed and competent individuals.

Priorities to meet the nine outcomes above include:

» Strengthening the health system
» Improving health information systems
» Prevention and reduction of disease burden, and promotion of health
» Financing universal healthcare coverage

- » Improving health sector workforce
- » Strengthen management accountability mechanisms
- » Increase reliance on evidence based outcomes
- » Develop meaningful public-private partnerships

Healthcare product opportunity areas at a less strategic level include new and innovative medical equipment, as extensive upgrades and development of hospital infrastructure are being considered.

NEEDS ANALYSIS AND GAP IDENTIFICATION

Many of the gaps and needs are in non-clinical care areas, which alleviates the need for clinical expertise. Each of the following Opportunity Areas benefit from comprehensive needs analysis and gap identification. It is important to note that, the larger the enterprise, the harder it is to determine gaps and express needs with specificity – and specificity is required to predict and control costs.

INDIVIDUAL AND TEAM EDUCATION AND TRAINING

South Africa first needs to increase the healthcare workforce and the capabilities of that workforce. There is a distinct need to grow new schools, matched by the need to expand and improve the quality of basic and continuing education provided to medical, nursing, and allied health students.

At select locations, and as the broadband infrastructure grows, opportunities exist to develop and deploy computer based training as an augment to traditional education, as well as to support continuing medical/nursing education and accreditation. This is especially true as South Africa seeks to expand their nursing and midwife workforce as a means to extend care to more rural populations. Extending these capabilities to mobile accessible tools such as smartphones will further increase their reach and impact, as the population communicates largely via mobile networks.

INTEGRATION OF DISPARATE MISSION CRITICAL SYSTEMS

The South Africa eHealth initiative is a massive IT enterprise architecture design and implementation problem. There is an appreciation for the integration of South Africa's disparate healthcare systems, and the desire to do so is reflected strategically in the National Development Plan 2030 as well as the 2014-2019 Department of Health Strategic Plan. The eHealth initiative will take a number of years to design and implement. The government is interested in developing a solution collaboratively as opposed to purchasing a turnkey solution.

DATA ANALYSIS AND ANALYTICS

South Africa appreciates the promise of healthcare analytics, but lacks a cogent path to implement the capability in the near future. There are, however, efforts worth examining.

The National Institute of Health Collaborative Center called Human Heredity and Health in Africa (H3Africa) is studying the genomic/genetic/environmental contributors of human health and disease within Africa using cutting-edge genomic research tools, to increase capacity for biomedical research in Africa, in terms of building infrastructure (including data and research resources), and to increase the genomic proficiency of researchers and trainees in Africa (not just South Africa).

The vision of H3Africa is to create and support a pan-continental network of laboratories that will be equipped to apply leading-edge research to the study of the complex interplay between environmental and genetic factors that determines disease susceptibility and drug responses in African populations. Data generated from this effort will inform strategies to address health inequity and ultimately lead to health benefit in Africa.

To achieve this, the following issues must be addressed:

- » Ensuring access to relevant genomic technologies for African scientists
- » Facilitating integration between genomic and clinical studies
- » Facilitating training at all levels, and particularly in training research leaders
- » Establishing necessary research infrastructure

DATA SYSTEM DESIGN AND DEPLOYMENT

South Africa wants to develop a business and enterprise architecture for eHealth, which would include developing a complete system design for a National Integrated Patient based information system. Their goal is to have system design completed for this system by 2019.

The Department also wants to develop and implement an integrated monitoring and evaluation plan aligned to health outcomes and outputs. The desire is to have the plan for this capability completed by 2019. Lastly, the Department wants to establish a coordinated disease surveillance system, with a strategy and plan for implementation in place by 2019.

According to the National eHealth Strategy, the following are specific eHealth challenges, particularly in the public sector. These challenges can be interpreted as specific data systems and IT opportunity areas for Virginia defense companies.

- » No national eHealth strategy and corresponding Enterprise Architecture supporting the national health system.
- » Limited capacity or capabilities within the public sector to implement a national eHealth strategy.
- » Widely differing levels of eHealth maturity across and within provinces.
- » A large number of disparate systems between which there is little or no interoperability and communication.
- » Silos of information within levels of government, government departments and programs within the national and provincial departments of health, resulting in duplication of effort and disparities in reporting.
- » Inequity of eHealth services provided and expenditure on eHealth across national and provincial departments of health. (This may be related to differing strategic importance placed on eHealth).
- » Broadband connectivity is expensive and still out of reach of many.
- » A low degree of cooperation, collaboration and sharing across all sectors.
- » Several past initiatives have not reached fruition because of poor planning or lack of consistent sponsorship, management and/or funding.
- » Need for strong information governance to ensure compliance with the necessary standards and procedures for, and appropriate use of, health information (both patient-based and aggregate).
- » Different organizational structures for eHealth service provision exist in provinces, e.g. health information and computer technology (ICT) services may reside within a department of health but in an inappropriate section, or within another department.
- » The absence of a national master patient index and lack of consensus on unique identification of patients.
- » A lack of cooperation between various groups resulting from lack of a clear understanding that eHealth includes all ICTs for health such as mobile technologies, telemedicine and electronic pa-

tient records. This lack of cooperation prevents urgently needed progress in using eHealth as an enabler.

Telemedicine, mentioned above, is a true capability multiplier in South Africa. Telemedicine helps provide access to geographically dispersed patients and caregivers.

OPPORTUNITY OVERLAP SYNOPSIS

Based upon research and analysis performed for this report, the subjective opportunity for Virginia defense companies in the below areas can be evaluated as Low, Medium, or High.

Again, these are subjective assessments based upon a number of factors particular to each healthcare sector area, including but not limited to:

- » Identification of gaps, needs, and shortcomings relevant to the healthcare sector area
- » Plan to address gaps, needs, and shortcomings
- » Progress made addressing gaps, needs, and shortcomings
- » Relative match of general defense capability to identified gaps, needs, and shortcomings

A Low characterization reflects a challenging market opportunity.

A Medium characterization reflects a market opportunity with strong potential.

A High characterization reflects a market opportunity that is a good fit for Virginia defense companies.

Overlap Potential		
U.S. Defense Industry Capabilities & Expertise	*International Healthcare Sector Areas*	*South Africa Opportunity*
Requirements Capture & Analysis	Needs analysis and gap identification	Medium
Individual & Team Training	Individual and team education and training	High
System Integration and Interoperability	Integration of disparate mission critical systems	Medium
Operations Research	Data analysis and analytics	Low
Security & Enterprise IT	Data system design and deployment	High

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UNITED ARAB EMIRATES

Established on December 2, 1971, the United Arab Emirates (UAE) is a federation of seven emirates, including Abu Dhabi, Dubai, Sharjah, Ras Al Khaimah, Ajman, Umm Al Quwain and Fujairah. UAE official language is Arabic. The capital of the UAE is Abu Dhabi.

The UAE constitution lays out the organization and components of the state. UAE federal authorities include the Federal Supreme Council, President and Vice President, the Cabinet, Federal National Council, and the Federal Judicial Authority. The legal system is a mix of Islamic law and civil law. Each of the seven emirates are controlled a local government that aligns with the Federal government.

UAE nationals make up 11% of the UAE population (2011). The UAE workforce is comprised mainly from people from India, Pakistan, Sri Lanka, Bangladesh, Philippines, North America and Europe, Iran, Egypt, and Palestine.

The UAE economy is centered on the oil and gas industry.

UAE's currency is the Dirham (AED); $1 US is approximately equivalent to 3.672 AED.

The Central Intelligence Agency and International Monetary Fund consider UAE neither a Developed Country nor an Advanced Economy, respectively.

Population	9.346 million (2013)
Urban population	85%
Country size	32,278.1 sq mi
Median age	30
Population growth rate	1.5%
Birth rate	15 per 1000
Death rate	1.99 per 1000
Life expectancy, years	76 (m) / 78 (f)
Literacy rate	92%
GDP (US$ billions)	$402.3 (2013)
GDP per capita (US$)	$43,048.90 (2010-14)
Health expenditures	2.8% of GDP (2014)

HEALTHCARE IN THE UNITED ARAB EMIRATES

The UAE is in the midst of expanding its national healthcare system. Changes in population and economic diversification are driving this change. US medical centers, corporations, organizations, and academic institutions are actively participating in this expansion. The main focus is on rapidly growing the clinical infrastructure, followed by workforce development.

At the federal level, the Ministry of Health regulates public healthcare and the Emirates Health Authority takes care of service delivery. At the emirate level, there are two management organizations: the Health Authority Abu Dhabi and the Dubai Health Authority.

Private healthcare service providers are non-government run clinical services that provide specialty and full-spectrum care for the population.

UAE citizens suffer from many of the same issues faced by advanced economies, such as diabetes, obesity, heart disease, and cancer.

HEALTHCARE FINANCING

In 2012, the UAE spent $11 billion (USD) on healthcare. Households pay twenty percent of the UAE healthcare expenditure. The government and others expend the remaining 80 percent.

Insurance is compulsory through the UAE. Nationals have access to care through various national level plans; expatriated residents have access to plans available through their employer or available for purchase. Insurance companies like Daman and the Insurance System for Advancing Healthcare in Dubai (ISAHD) are examples of federal and emirate level companies in this market.

HEALTHCARE DELIVERY

The United Arab Emirates has 33 public and 71 private hospitals with a number of new health care facilities planned. US and other international partners are often relied upon for daily operations of clinical services. For the past decade, UAE has partnered with a number of different successful US health systems to help develop the UAE healthcare delivery infrastructure. Organizations like the Cerner Corporation, Cleveland Clinic, MD Anderson, GE Healthcare, Truven Health Analytics, and the New England Center for Children have a long and successful in-country partnership with UAE.

Major US universities, such as John Hopkins and Harvard, have been commissioned to improve the management and services of hospitals and build capacities in accreditation. Legislation, standards and protocols are in place for health care quality assurance within the UAE system, but monitoring, appraisal and evaluation need to be strengthened in order to improve quality and patient safety.

HEALTHCARE IT

The Ministry of Health and the health authorities of Abu Dhabi and Dubai collect health information. An integrated system does not exist to harmonize, align, consolidate and report health information at the federal level.

Healthcare IT in the U.A.E. consists primarily of independent healthcare systems. Integration of these systems into a nationally accessible capability is a priority. One example of this effort is Wareed, a federal level effort to integrate electronic medical records in all public healthcare centers across Dubai and the Northern Emirates. Wareed will also automate all healthcare processes across administrative and clinical departments.

PRECISION MEDICINE

Precision medicine is being developed as a capability very slowly and methodically in the UAE. It is not yet developed or employed through the system. Most of the capabilities that exist and in development rely on US and other external healthcare partners.

HEALTHCARE EDUCATION

Workforce development is a high priority for UAE leadership. In 2012, 15% of physicians and 13% of nurses left the UAE healthcare system for mostly international opportunities. The country is still trying to recover from this exit. Some of the issues leading to the exit include an inefficient licensing process, inadequate healthcare infrastructure, few opportunities for continuing and graduate education, and the generally better opportunities overseas.

Investments are being made to ensure creation of a local workforce, which is important for healthcare system sustainment – especially as the UAE grows their middle class.

Physician, nurse, and allied health professional schoolhouse and continuing education are critical to the expanding UAE healthcare system.

Partners in UAE education development include the Accreditation Council for Graduate Medical Education International, The Dubai Harvard Medical Research Foundation, the Houston Methodist Global Health Services, Mayo Clinic, Johnson & Johnson, and the Johns Hopkins Bloomberg School of Public Health.

» 5 Medical Schools
» 6 Universities with Nursing Programs
» 19 Universities with Medical Technology Programs
» Unknown number of Healthcare Simulation Centers
» 8 Dental Schools

MARKET ACCESS

The UAE has a tax-free and business friendly environment, with a commitment to keep it that way. Social unrest prevalent throughout the regions has not impacted the UAE, which makes it a relatively safe environment for businesses.

Doing business with the UAE requires a commitment to developing local shareholders and partnerships. Partners are critical, and must be established early. The UAE wants to capitalize on the value that international partners can bring, but they value collaboration and a commitment to developing their local workforce. Face to face interactions are part of the trust building required to keep business activities alive. Further, patience and perseverance are critical mindsets to keep working with UAE partners.

The UAE is included in the list of countries reissued by the US Treasury Department that require cooperation with or participation in an international boycott as a condition of doing business. The listed countries are identified pursuant to section 999 of the US Internal Revenue Code (IRC), which requires US taxpayers to file reports with the Treasury Department concerning operations in the boycotting countries. Along with UAE, the countries on the list include Iraq, Kuwait, Lebanon, Libya, Qatar, the Republic of Yemen, Saudi Arabia and Syria.

A company can establish a formal presence in the UAE under UAE law. The UAE Commercial Companies Law requires that each company established in the UAE have one or more UAE national partner(s) who hold at least 51% of the company's capital.

The United Arab Emirates has been a member of World Trade Organization (WTO) since 10 April 1996, and a member of the General Agreement on Tariffs and Trade (GATT) since 8 March 1994.

OPPORTUNITY AREAS FOR VIRGINIA DEFENSE CONTRACTORS

UAE is unique amongst is regional neighbors in that both the federal and emirate governments are committing significant strategic investments, with a focus on driving the healthcare industry forward. Like most economically advanced countries, the cost to provide healthcare has staggering implications to the national economy.

According to a 2014 US-UAE Business Council Report:

> *Expertise in medical supplies, equipment, and management services are in constant demand. This includes cardiovascular medical devices, firms that can design and build hospitals, and healthcare organizations that have experience administering and staffing general hospitals and specialty clinics. Once the appropriate information technology infrastructure is in place, supply chain management solutions will become another area of opportunity. U.S. companies have much to offer in all of these spheres. However, those planning to pursue such opportunities should become familiar with the public tender process used in the U.A.E. to award such contracts.*

The UAE national health strategy is based on the overall government strategy of 2011–2013, focusing on a comprehensive and effective health system for communal health. According to the World Health Organization UAE Country Coordination Strategy, UAE's strategic health objectives are to:

» Enhance and strengthen the Ministry of Health's role in setting and applying policies, regulations and governance guidance at federal level;

» Develop and improve the Ministry of Health infrastructural facilities;

» Enhance and develop the health care safety system to counter health hazards;

» Promote public health care standards and raise public health care awareness among the community on international standards;

» Ensure and guarantee provision of comprehensive health care services up to international standards;

» Support, enhance and apply scientific research and health care studies;

» Ensure and guarantee the provision of central administrative services according to applied quality, efficiency and credibility standards;

» Ensure and guarantee the provision of decentralized administrative services according to applied quality, efficiency and credibility standards;

» Improve auxiliary support to health care services.

NEEDS ANALYSIS AND GAP IDENTIFICATION

Many of the gaps and needs are in non-clinical care areas, which alleviates the need for clinical expertise.

Each of the following Opportunity Areas benefit from comprehensive needs analysis and gap identification. It is important to note that, the larger the enterprise, the harder it is to determine gaps and express needs with specificity – and specificity is required to predict and control costs.

INDIVIDUAL AND TEAM EDUCATION AND TRAINING

The UAE education and training market is growing, and demand for improved access and quality of education and training is high; however, there is significant reliance upon the existing partnerships with US and other countries relative to educational development. Access to this market may best occur by creating partnerships not with the UAE, but with US companies already in the UAE market.

INTEGRATION OF DISPARATE MISSION CRITICAL SYSTEMS/ DATA SYSTEM DESIGN AND DEPLOYMENT

The Wareed initiative, mentioned previously, is an ongoing effort to build and deploy IT infrastructure, and integrate electronic medical records and departmental processes across the country. Wareed is being

developed with the assistance of Cerner Corporation, so any opportunities in this area would best be served through partnership with that Kansas City-based company.

DATA ANALYSIS AND ANALYTICS

Opportunities exist in the area of data analytics relative to both administrative (insurance, billing, reimbursements) and clinical needs. The UAE spends roughly $1,200 USD per person, annually. This puts the UAE in the top 20 countries in the world for healthcare spending per capita – which also means that healthcare spending is unsustainable. The UAE can rely upon data analytics to help ascertain areas where operational efficiencies can be achieved.

Truven Health Analytics developed a hospital rating system for the UAE, making them a company with which to consider partnership. Cerner Corporation also has experience providing data analytics services in the UAE.

OPPORTUNITY OVERLAP SYNOPSIS

Based upon research and analysis performed for this report, the subjective opportunity for Virginia defense companies in the below areas can be evaluated as Low, Medium, or High.

Again, these are subjective assessments based upon a number of factors particular to each healthcare sector area, including but not limited to:

- » Identification of gaps, needs, and shortcomings relevant to the healthcare sector area
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- » Relative match of general defense capability to identified gaps, needs, and shortcomings

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Overlap Potential		
U.S. Defense Industry Capabilities & Expertise	*International Healthcare Sector Areas*	*United Arab Emirates Opportunity*
Requirements Capture & Analysis	Needs analysis and gap identification	Low
Individual & Team Training	Individual and team education and training	Low
System Integration and Interoperability	Integration of disparate mission critical systems	Low
Operations Research	Data analysis and analytics	Medium
Security & Enterprise IT	Data system design and deployment	Medium

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UNITED KINGDOM

The United Kingdom of Great Britain and Northern Ireland is commonly referred to as United Kingdom (UK). Great Britain is made up of England, Scotland, and Wales. The UK is a constitutional monarchy and Commonwealth realm, and is also a member state of the European Union (EU).

Population	62.7 million
Urban population	79%
Country size	94,058 sq mi
Median age	40.4 years
Population growth rate	0.54%
Birth rate	12.22 per 1000
Death rate	9.34 per 1000
Life expectancy, years	80.8
Literacy rate	99%
GDP (US$ billions)	2,440.5
GDP per capita (US$)	38,589
Health expenditures	9.3% of GDP (2011)

The US – EU exchange rate is roughly 1 Euro (symbol: €) per $1.12 US. The US – UK exchange rate is roughly 1 British pound sterling (symbol: £) per $1.54 US.

The Central Intelligence Agency and International Monetary Fund consider the UK both a Developed Country and an Advanced Economy, respectively.

HEALTHCARE IN THE UK

The National Health Service (NHS) is traditionally regarded as one system, and receives funding from central government, but is essentially managed as four separate segments: NHS Wales, NHS Scotland, HSC Northern Ireland and NHS England.

Health services in England are largely free at the point of use. Established in 1948, the NHS provides preventive medicine, primary care and hospital services to all those "ordinarily resident" in England. Over 12% of the population is covered by private medical insurance (PMI), which mainly provides access to acute elective care in the private sector.

Responsibility for publicly funded health care rests with the Secretary of State for Health, who is accountable to parliament. The Department of Health is the central government body responsible for setting policy on the NHS, public health, adult social care and other related areas. The main role of the Department is to support the government in improving the health of the population in England; it sets overall health policy and strategy, as well as dealing with legislation and regulation.

The Department of Health operates at a regional level through 10 strategic health authorities (SHA), which are responsible for ensuring the quality and performance of local health services within their geographic area. Responsibility for commissioning health services (CHS) at the local level lies with 151 primary care organizations, mainly primary care trusts (PCT), each covering a geographically defined population of, on average, just over 340,000 people. Since 2005, General Practitioners (GP) have also played a role in commissioning through the development of practice based commissioning.

HEALTHCARE FINANCING

Health services in England are mainly financed from public sources – primarily general taxation and national insurance contributions (essentially nationalized healthcare premiums). Some care is funded through private medical insurance, such as some user charges, cost sharing and direct payments for health care delivered by NHS and private providers.

HEALTHCARE DELIVERY

The first point of contact for general medical needs is usually self-employed GPs and their practices, typically entering into contractual engagements with PCTs, although GPs may also be employed directly by alternative providers (e.g. commercial sector). Community health services, NHS Direct, NHS walk-in centers, dentists, opticians and pharmacists are part of NHS primary care services. The primary care system also plays a gate-keeping role in determining access to more specialized, often hospital-based, acute health care services.

Salaried specialist doctors (consultants), nurses, and other health care professionals (e.g. physiotherapists and radiologists) working in government-owned hospitals (NHS trusts) provide NHS-funded secondary care. A small private sector exists alongside the NHS, funded through private insurance, direct payments from patients, or publicly funded payments by PCTs and the Department of Health, and mainly provides acute elective care. To access NHS specialist care, patients require a referral for a consultation from a GP. Patients can also pay out of pocket for a private consultation or be referred through a PMI scheme if they are members of such a scheme.

In addition to secondary care, a range of more specialized tertiary services are also provided by NHS trusts and deal with more complex or rare conditions. These trusts are usually also linked to medical schools or teaching hospitals, as well as being centers of research in their fields. A secondary care specialist mostly refers patients to a tertiary center, although direct referrals by GPs are also possible. In addition, most tertiary centers also provide some private health care services.

HEALTHCARE REFORM: PAY FOR PERFORMANCE

The NHS in England spent more than £110 billion (~$169 billion USD) in 2012/13. This covers a huge range of health care services from preventive to palliative, and routine to emergency. Services are provided by a large number of diverse providers in varied settings across the country, including general practice, hospitals and community nursing services. The balance of spending across these services must be optimized if the appropriate services are to be available to population groups in an equitable manner.

The shift from block budgets to activity-based payment in the acute sector has supported patient choice, making providers compete on the basis of quality rather than price. Features associated with the success of pay-for-performance schemes in the English NHS have been: a clear evidence base, clinical engagement and support, sufficient longevity to encourage investment in change by providers, feasibility in practice, and simplicity.

HEALTHCARE IT

Over the last 60 years, the development of IT systems to help with the delivery of patient care in the NHS has been piecemeal with organizations developing their own solutions, and a wide range of IT systems and providers used. Until recently, it had been left to each NHS trust to decide what IT systems were needed and how much money should be allocated to IT. Spending on IT was low. There was no overall system-wide approach and so hospitals developed their own small stand-alone systems. The lack of any common standard combined with few financial incentives resulted in inconsistent IT development.

Healthcare IT modernization efforts have been ongoing since 1998, with minimal impact. In fact, the entire NHS National Programme for IT was essentially canceled in 2011. Today, the Health and Social Care Information Centre, the national provider of information, data and IT systems for health and social care, manage most of the NHS IT systems.

Below is a list of activities that were successfully completed under the Program before it was canceled:

» **Secondary User Service (SUS)**
  » The SUS is the single, comprehensive repository for healthcare data in England, which enables a range of reporting and analyses to support the NHS in the delivery of healthcare services.
» **The Spine**
  » The Spine holds the demographic information of 80 million people, as well as controlling the messaging between key applications used in the delivery of patient care, for example, the Electronic Prescription Service, Summary Care Record and Choose and Book.
» **NHS Care Records Service (NHS CRS)**
  » Introduced to improve the safety and quality of patient care. It gives health-care staff faster, easier access to reliable information about patients.
» **Choose and Book**
  » A national electronic referral service which gives patients a choice of place, date and time for their first outpatient appointment in a hospital or clinic
» **Electronic Prescription Service (EPS)**
  » EPS enables prescribers to send prescriptions electronically to a dispenser (such as a pharmacy) of the patient's choice.
» **New National Network (N3)**
  » The NHS national broadband network linking hospitals, medical centers and general practitioners in England and Scotland, which replaced NHSnet. It is one of the largest Virtual Private Networks in Europe. N3 underpins the NHS National Programme for IT, the world's largest civilian IT program.
» **E-mail and directory service (NHSmail)**
  » NHSmail is a secure email service. It is the only NHS email system accredited to 'Government OFFICIAL SENSITIVE' status approved by the Department of Health and endorsed by professional bodies, for the purpose of sharing patient identifiable and other sensitive information.
» **Picture Archiving and Communications Systems (PACS)**
  » PACS enables x-ray and scan images to be stored electronically and viewed on screens, helping to improve diagnosis methods.

PRECISION MEDICINE & VPH

The Virtual Physiological Human (VPH) is a European Union effort focused on developing a methodological and technological framework that, once established, will enable collaborative investigation of the human body as a single complex system. It aims to be descriptive, integrative and predictive:

» **Descriptive**. The framework should allow observations made in laboratories, hospitals and the field, at a variety of locations situated anywhere in the world, to be collected, catalogued, organized, shared and combined in any possible way.

» **Integrative**. The framework should enable experts to analyze these observations collaboratively and develop systemic hypotheses that involve the knowledge of multiple scientific disciplines.

» **Predictive**. The framework should make it possible to interconnect predictive models defined at different scales, with multiple methods and varying levels of detail, into systemic networks that solidify those systemic hypotheses; it should also make it possible to verify their validity by comparison with other clinical or laboratory observations.

The framework is formed by large collections of anatomical, physiological, and pathological data stored in digital format, by predictive simulations developed from these collections, and by services intended to support researchers in the creation and maintenance of these models, as well as in the creation of end-user technologies to be used in the clinical practice.

The VPH development effort is being continued as the VPH Institute. Additional funding for development is provided through the Horizon 2020 (H2020) funding mechanism. H2020 is the biggest EU Research and Innovation program ever with nearly €80 billion (app $91 billion US) of funding available over seven years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market.

H2020 is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness.

Seen as a means to drive economic growth and create jobs, H2020 has the political backing of Europe's leaders and the Members of the European Parliament. They agreed that research is an investment in our future and so put it at the heart of the EU's blueprint for smart, sustainable and inclusive growth and jobs. Importantly, H2020 permits US partners on proposal teams.

The following UK organizations are participating members of the VPH effort:

» DePuy (subsidiary of Johnson & Johnson)
» Kings College London, Biomedical Engineering Department, Division of Imaging Sciences and Biomedical Engineering
» University College London
» University of Bedfordshire, Centre for Computer Graphics & Visualisation
» University of Nottingham, Centre for Mathematical Medicine & Biology
» University of Oxford, Department of Computer Science (Computational Biology Group)
» University of Sheffield

HEALTHCARE EDUCATION

Similar to the US, UK healthcare training and education takes place in the schoolhouse environment, during on-the-job supervised encounters, and during refresher/certification/recertification events. Being an economically advanced country, the UK is home to a prolific healthcare educational system. The General Medical Council sets standards for medical students and doctors. The Nursing and Midwifery Council regulates nurses and midwifes in the UK.

Several recent initiatives have initiated significant changes in the UK healthcare education system, all focused on ensuring the UK has the best educated personnel in place, in the right numbers and locations, to meet the projected changes in the UK health landscape.

» 34 Medical Schools

- » 72 Universities with Nursing Programs
- » 29 Universities with Medical Technology Programs
- » At least 32 Healthcare Simulation Centers
- » 18 Dental Schools

MARKET ACCESS

Virginia defense companies should not encounter any political or trade barriers to market entry. The UK adheres to EU procurement rules and conducts most buying through commercial negotiation. However, the NHS faces significant financial pressure, driving cost based decisions over outcome based decisions.

According to the Office of the United Stated Trade Representative,

> *The U.S. economic relationship with the EU is the largest and most complex in the world, generating goods and services trade flows of about $2.7 billion a day [2012 estimate] and transatlantic investment is directly responsible for roughly 6.8 million jobs [2010 estimate]. This enormous volume of transatlantic trade and investment promotes economic prosperity on both sides of the Atlantic and in the dozens of other countries that trade with the transatlantic partners. The United States and the EU continue to pursue initiatives to create new opportunities for transatlantic commerce.*

A significant hurdle for Virginia companies interested in clinical devices is the UK's National Institute of Health and Clinical Excellence (NICE). NICE is similar to the Center for Medicare and Medicaid (CMS) in the US, as it judges the clinical and cost-effectiveness of new and existing drugs, treatments, and medical devices. NICE provides the NHS with guidance on treatment strategy and influences procurement decisions by stating which products are reimbursable on the NHS. Another hurdle can be the UK equivalent to the FDA, which is the Medicines and Healthcare Products Regulatory Agency (MHRA). MHRA regulates medicines and medical devices in the UK.

Many US healthcare vendors have subsidiary organizations or partner relationships in the UK, which enables them to trade in the healthcare market as natives.

OPPORTUNITY AREAS FOR VIRGINIA DEFENSE CONTRACTORS

It is important to note that, in all virtually all cases, the primary customer for any service, technology or capability is the UK National Health System. The secondary customer base includes private care providers, which provide a lesser set of treatments than the NHS, and is also found in a subcontractor role to the NHS.

NEEDS ANALYSIS AND GAP IDENTIFICATION

National Health Service leaders are under significant pressure to optimize health services cost and delivery. Over the next few years, the NHS seeks £20 billion (app. $30 billion US) in efficiency savings. Given the fact that the NHS is the largest health system in the world, there is a need to identify gaps and needs across their geographically dispersed enterprise.

Many of the gaps and needs are in non-clinical care areas, which alleviates the need for clinical expertise.

Each of the following Opportunity Areas benefit from comprehensive needs analysis and gap identification. It is important to note that, the larger the enterprise, the harder it is to determine gaps and express needs with specificity – and specificity is required to predict and control costs.

INDIVIDUAL AND TEAM EDUCATION AND TRAINING

The UK, as a whole, is technically savvy. Students and the younger practitioners want to engage learning in less didactic, more interactive and dynamic environments. Organizations like UK Learning are focused on improving learning opportunities throughout the UK, and are focused on innovative approaches, design of learning, and leveraging technology. This attitude is permeating all levels of UK education, but implementing change is challenging.

There is a significant opportunity to engage the UK healthcare market by providing new and novel approaches to learning and assessment. UK healthcare teachers, students, and practitioners already utilize simulators to support practice of repetitive and intrusive tasks. What is missing from almost every vendor-supplied simulator is the ability to assess and validate task performance. Typically, assessment is subjective and to an observable, as opposed to measureable, standard. This approach does not match the UK goal to measure practitioner performance and quality as a cost reducer.

Virginia defense companies that specialize in interactive and dynamic learning, learning management, and modeling and simulation in support of training have a unique opportunity to engage this market at the national level within the UK. Approaching both individual educational institutions and modeling and simulation organizations may be a good first approach.

The largest organization in the UK dealing with healthcare modeling and simulation is the Association for Simulated Practice in Healthcare. Formed in 2009, the overarching goal of the Association for Simulated Practice in Healthcare (ASPiH) is to enable wider sharing of knowledge, expertise and educational innovation related to simulated practice across the healthcare professions.

INTEGRATION OF DISPARATE MISSION CRITICAL SYSTEMS

The NHS suffers from the same integration and interoperability challenges that all US healthcare systems face. Equipment, devices, and systems are acquired over time and typically as stand-alone capabilities with minimal native interoperable capability. Systems are developed and sold as stand-alone products; there is little incentive for manufacturers to develop integrated capabilities. This situation is exacerbated by the fact that the NHS has to develop a strategic timeline for the implementation of any and all integration efforts, based upon the funding cycle, a desire to spend less and the push to "optimize" NHS operations.

There are multiple NHS IT initiatives in play that are focused on the patient data and payments end of patient care. These are systems that are quickly recognized as needing streamlining because they are critical to the management of NHS. For instance, the NHS Health and Social Care Information Centre, the UK provider of information, data and IT systems for health and social care, has established an Interoperability Toolkit (ITK) to foster data exchange standardization between NHS providers. The NHS ITK initiative was a direct response to the move to a "Connect All" strategy initiated in 2009. Until that point a "Replace All" strategy had been pursued through the awarding of major contracts to local service providers. Clearly, a "Replace All" strategy is unsupportable.

There is an opportunity to assist with the integration of clinical care mission critical systems to provide additive information to the patient data collection and sharing chain. There remains considerable opportunity to integrate pure data systems, but there are efforts in place to address these integrations. Real time capture and dissemination of patient data from monitoring devices, both inpatient and secondary care facilities is a goal, but is not yet fully in place.

DATA ANALYSIS AND ANALYTICS

NHS's goal to find tens of billions in efficiency savings relies significantly upon investigating myriad processes and decisions made over time. A 2012 report titled *Data Equity: Unlocking the value of big data* estimates that over £250 billion (~$384 billion USD) in benefits can be achieved through knowledge gained by exploiting "big data."

Personalized medicine is, at its center, a data analytics and analysis problem. The UK NHS appreciates the value in pursuing technologies supporting personalized medicine. This is evidence by their involvement in the Virtual Physiological Human (VPH) Project, genomic analysis efforts, and the creation of various personalized medicine centers and coalitions. Conceptually, personalized medicine relies on the creation of useable information from massive sets of collected data, and the need to find valid relationships within that data and information in order to further deduce causality and support prediction of future disease and health status. It is also critical to developing a culture of patient-centered, compassionate and responsive care.

Throughout the UK, more and more healthcare data is being collected and integrated into the electronic healthcare record system. The relationship of these records to personalized medicine is obvious; however, the value of this data in aggregate is important to creating more generic models of both the "common patient" and the state of a community's health.

Many Virginia defense companies have a data analytics capability that has been used to support operations analysis, intelligence, and some cyber tasks. This is a relatively strong area to pursue in the UK. The NHS is using Narrative Science's Quill™ software to transform some tabular and spreadsheet data into narrative information for consumption on the NHS Choices website. Near real time analytics, causality information, and predictive analytics are the harder problems for the NHS.

DATA SYSTEM DESIGN AND DEPLOYMENT

The NHS is nearing the end of a ten-year IT system upgrade – one that relies upon both deployment of new/replacement infrastructure and capabilities fostering interoperability. Coupled with the growing need to collect, secure, and harness data – and the very large scale and scope of the NHS – and the UK just may have the most challenging IT problem in the world.

OPPORTUNITY OVERLAP SYNOPSIS

Based upon research and analysis performed for this report, the subjective opportunity for Virginia defense companies in the below areas can be evaluated as Low, Medium, or High.

Again, these are subjective assessments based upon a number of factors particular to each healthcare sector area, including but not limited to:

» Identification of gaps, needs, and shortcomings relevant to the healthcare sector area
» Plan to address gaps, needs, and shortcomings
» Progress made addressing gaps, needs, and shortcomings
» Relative match of general defense capability to identified gaps, needs, and shortcomings

A Low characterization reflects a challenging market opportunity.

A Medium characterization reflects a market opportunity with strong potential.

A High characterization reflects a market opportunity that is a good fit for Virginia defense companies.

Overlap Potential		
U.S. Defense Industry Capabilities & Expertise	International Healthcare Sector Areas	United Kingdom Opportunity
Requirements Capture & Analysis	Needs analysis and gap identification	Low
Individual & Team Training	Individual and team education and training	Medium
System Integration and Interoperability	Integration of disparate mission critical systems	Medium
Operations Research	Data analysis and analytics	Medium
Security & Enterprise IT	Data system design and deployment	Medium

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