OF TWO MINDS:
One Human, One Not
Mental Health in the Era of Artificial Intelligence
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The world is crossing an historic bridge spanning human and artificial intelligence. The result is a meeting of two minds – one human, one not. Can we keep them both healthy? That is unclear

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Bill was named a Founding Fellow of the Mental Health Institute at the University of British Columbia and Adviser-Neuroeconomics to the Scientific Director, Douglas Mental Health Institute, Montreal. Bill has had a long career as a chief and senior executive in business, broadcasting, arts and government, he was a consultant in corporate crisis management and early in his working life, a writer and newspaper reporter.

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Great West Life has a strong presence in the mental health field, having created the GWL Centre for Mental Health in the Workplace 11 years ago and continues to invest in the Centre as a source of public information and analysis. Great West has been an active supporter of the Global Business and Economic Roundtable on Mental Health and Mental Health International.

Most sincerely, we thank both companies for their generosity and support of work dedicated to helping resolve complex issues of the nature discussed in this report.

PURPOSE OF THIS REPORT

This report aims to reach leaders in government, science and business with an alert and recommendation that artificial intelligence must be managed and managed carefully to prevent it from becoming a major intruder into the mental health and well being of working populations and families. We cite the spectre of Unintended Consequence.

We ask: will enthusiasts and inventors and scientists and designers and early users of AI exercise the kind of vigilance and diligence necessary to not make things worse in a highly symptomatic world of mental disquiet and social, economic, cultural and political divisions – divisions that can be widened and deepened with tools and technology now available to create real chaos.

In this light, the author submits that the mental health of nations is a useful barometer as to the state of mind and concern and apprehension and self-awareness of human beings as they contend with change of a nature that seems barely containable. We ask leaders to manage the introduction of AI innovations carefully and to engage the everyday public in doing so.

SUMMARY OF PRINCIPAL RECOMMENDATIONS

Unify the AI, Genomics and Genetics Revolutions Through International Mental Health.

One principal recommendation of this report is for Dr. Bernstein and his colleagues and the Government of Canada and Dr. Remi Quirion, Chief Scientist of Quebec and the Government of Quebec to incorporate mental health considerations into the development of the Pan-Canadian Strategy on Artificial Intelligence, and into the work of the Quebec-Observatory on the Societal Impact of Artificial Intelligence.

The timing is appropriate for this action - given forecasts by governments around the world – as to the effects of AI on society combined with the high risks it will pose for job security and retention in the global digital economy and job markets across the world.

The pressures emanating from this extraordinary transition have the potential to tighten the grip that mental illness has on working populations and families world-wide through wide tracts of chronic stress, frustration and rumination if introduced in an unmanaged way.

At the same time, the human genome which all human beings are born with and its interaction with the environment we are born into, and in which we live and work, produce the dynamics which can set the stage or even cause mental illness.

Scientific evidence of this interaction comes from the newer field of epigenetics which relates not to the sequence of our genes that we inherit from our parents but to the chemical modification of our genes leading to changes in their expression. These changes in gene expression are now thought to affect critical biological changes that may affect health and disease, including mental illness.

The integration of mental health into the revolutions in artificial intelligence, genomics, genetics and epigenetics will create a new vehicle for scientific collaboration to reduce disabling and deadly effects of mental disorders by reducing risk – this in a brain-based global economy which puts a high premium on brain-based skillsets as its main source of productive capacity.

We further recommend that in addition to incorporating mental health considerations into these major undertakings by Canada and Quebec, the health sciences, sociology (or social sciences) and other fields of science come together to define the impact of the troubling effects of the large train of major issues confronting the world today as risks to the mental health status of working and vulnerable populations and their families.

The point is this: while the OECD may report that 'we are not entering a jobless world quite yet', the apprehension that are headed in that direction will worry workers at a time when the world is wracked by extremist violence, global warming and economic inequality that wears heavily on the minds of parents, workers, managers, executives and all who look to the future for hope.

Mental Illness: The Problem Statement:

For purposes of 'segmenting' the so-called mental health crisis, the following is a problem statement against which to set goals and deploy research in the manner described in this Report:

Childhood Onset: average age of onset for anxiety disorders are childhood, substance abuse, teenage years and depression, early adulthood. This report identifies mental illness as a neurodevelopmental problem that develops before symptoms materialize early in life.

Disablement and Premature Death: mental illness increases the risk of premature death among those with other forms of chronic illness including cardiovascular disease, is the top cause of disability among working populations and the principal trigger of suicides.

Corrosion of Life Expectancy: mental illnesses are one significant cause of reducing life expectancy in some parts of the US, a signal and historic expression of the mental heath crisis.

Economic Costs: Mental disorders now wipe out four per cent of the gross domestic product of nations across the world, according to the OECD and WHO. The costs are now in the trillions, and, even at that, are probably understated due to the lack of research on the costs of co-morbidity with other chronic disorders and costs of care.

Social Dislocation: in Europe, there is evidence that mental disorders are causing a substantial increase in early retirements, slowly producing shortages in available skills and workers. A structural effect that could be long-lasting.

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The point, while the OECD may report that "we are not entering a jobless world quite yet," the apprehension associated with job loss linked to the infusion of artificial intelligence and with dominant worries such as extremist violence, global warming and economic inequality wears heavily on the minds of parents, workers, managers, executives and all who look to the future for hope.

Summary Part One:

What it means to be human in the era of artificial intelligence

The concept and uniqueness of our humanity will be challenged by the onset of AI. How it affects each of us remains to be seen but we should all be concerned that people with mental illness or with a predisposition to mental illness will be particularly affected by the advent of AI into our lives. Basic human qualities - love, compassion, knowledge, courage and discernment – will be needed more than ever to lighten that burden and ameliorate the impact of AI on our sense of self.

We will need all of our wisdom and the tools available to ensure that AI does not worsen the burden of mental illness on society. But AI is a quandary: its technologies may represent new tools to fight mental illness, but its vast infusion into society may well worsen the problem.

According to the World Economic Forum report, AI may force 375 million people to switch occupations in workplace operations and job markets across the world, producing invasive uncertainty, creating apprehension and threatening employees' sense of identity.

AI may well produce the kinds of stress that constitute a "negative valence system" producing specific risks of mental illness. At the same time, progress in the fields of neuroscience, genetics and epigenetics have opened new doors of hope that mental illness may one day be understood and eventually conquered.

There are strong economic incentives to invest in workforce and family mental health as the world enters a brain-based economy that puts a premium on brain-based skills vulnerable to stress as a cause of mental illness.

Summary Part Two:
Implications of the Revolution in Artificial Intelligence

Human vulnerability to artificial intelligence will likely be affected by how much AI permeates our everyday life and grows into the functions of society and the economy. Dropped like a bomb or introduced like a blizzard, AI has the potential to destroy the sense of self among many in our working populations.

What it means to be human is determined in significant measure by our self-awareness as to why we exist and whether, as we perceive it, we have the competence to live fulfilling lives on our own terms.

Notably:

If AI deepens the effects of distraction, isolation, fear and uncertainty which feed mental unrest, disquiet, disorder and illness, AI will damage society.

If AI enters the mainstream cloaked in confusion and a lack of transparency as to its purposes and effects, then it increases human distrust and human apprehension.

If AI displaces human beings from their jobs, without producing new employment opportunities through re-training and a re-focus on distinctly human qualities, then AI will be unwelcome.

Top scientists and business people who are proponents not opponents of AI are warning society about the dangers of the unintended consequences of artificial intelligence. To illustrate:

- As part of the Pan Canadian AI Strategy , CIFAR has mounted a series of workshops examining the impacts of AI on society in partnership with the leading research agencies in the UK (UKRI) and France (CNRS).
- The Government of Quebec has created an Observatory on the Societal Impact of Artificial Intelligence bringing sectors and institutions together from across the world.

The "Montreal Declaration" by AI advocates and scientists propounds the necessity to ensure AI benefits humanity. The Treasury Board of Canada has published an internal "Directive for Automated Decision-Making" based on a paper concerning, among many other things, the "physical and mental harms" and "discriminatory applications and uses of AI".

The Institute for Life organized signatories from 90 countries for a "Pledge for World Safety" which includes a vow never to develop killer robots. The late Stephen Hawking signed this Pledge.

European Union countries passed a motion to rebut the risks of autonomous weapons systems deployed for military purposes.

The "Asilomar Principles" were assembled by a broad coalition of AI leaders promising to "create not undirected artificial intelligence but beneficial artificial intelligence."

AI pioneer Kai-Fu Lee warns of greater inequality among and within nations while the CEO of IBM points to "social unrest" if workers are not prepared by employers and governments for the effects of an AI future through re-training and new jobs.

These concerns represent one side of the AI (potential) experience. There is another side – part of which is captured in the book "Artificial Intelligence and Behavioral Healthcare".

Research is underway to map the human brain using super-computing advances and to model neural networks, important to understanding how and why brain circuits trigger or are affected by mental illness.

AI will facilitate testing models of psychiatric illness and care to produce better outcomes for treating mental illness; one research team is modeling how schizophrenia develops.

Studies on 'Robots in Society' are aimed at helping the elderly to maintain their independence while augmented reality is being used to develop therapies for children living with autism and treating malignant melanoma.

Innovations in mental health through the applications of artificial intelligence:

New IBM research is using AI and machine learning algorithms to identify instances of schizophrenia with 74% accuracy combined with a capability to predict severity.

Efforts are underway to improve early detection and intervention, predict and diagnose depression, and monitor individuals' interaction with their world.

So, with all of the foregoing said, what is the question AI puts before us? In today's world of division, fake news, aberrant right-wing leaders, the stress epidemic, anger and frustration manifest in violence and alienation, decreasing life expectancy among other disturbing trends, is society simply too brittle, too vulnerable and too weary for yet more insurgent, in-your-face technology that could do good things and terrible things alike?

The former UN High Commissioner for Human Rights (2014-18), Zeid Ra'ad Al Hussein wrote in the Washington Post on April 9th.

"The hope is that this (technology advance), if augmented by ethical considerations, will serve the public good and be profitable and if not, the outcome could be ambiguous at best and devastating at worst.

"When there is peace and prosperity, liberal democracies are expanding, when repression is withering and when human rights are being honored, chances are technology generally will be put to good use. If the situation is opposite …. when democracies are failing and when repression spreads, when human rights are violated, and when nations are at war, technology will become a partner of bad intentions."

And he concludes: *"If we do not fix our breaking world – and that must be our priority – technology will likely only hasten the demise of the human race …. the possibility of salvation, therefore, lies in a few progressive governments joining the tech industry in the effort to slow down and ultimately reverse a decomposing international order. Technology cannot fix that."*

Apple CEO Tim Cook speaks to the need "to blend" technology with values. Which brings us to the proposition set forth in this report: an international inquiry into where AI is taking the world, what it will mean to ensure nations, not technology, assume that role and not allow technology to set the direction. The Montreal Declaration speaks to this. But does it have the teeth to chew on it. We propose certain measures in Part Five

Summary Part Three:

Implications of the Revolution in Genomics, Genetics and Epigenetics

As noted earlier, this paper is framed by Dr. Bernstein's alert that the "revolutions in genomics and artificial intelligence" are essentially challenging our established views of what it means to be human.

'Light of Hope'

In this Report, we see the revolution in genetics and epigenetics as the basis for a new understanding of mental illness and, therefore, the advent of new hope that these insights will lighten its burden.

That is not to say that the remarkable revolutions in advancing new technology will not produce benefits and progressive advantages. It is to say that unlike revolutions in technology in the past, the kind we are discussing and experiencing today are moving much closer to the replication, re-construction, and re-statement of our collective human identity.

Genomics, for instance, is attracting quickening interest through synthetic biology which involves "reading and writing" DNA. The objective of one project called Genome Project-Write is to synthesize the genomes of plants, animals and (possibly) humans in whole and part with a view (among other things) to fighting disease.

Genetic discoveries "represent the first absolutely objective clues as to what mental illnesses are a very basic cellular level." Human genetic studies, well-designed and carefully interpreted, can create a "direct route" to spelling out the mechanisms in the human brain that produce mental illness – a critical step toward better treatments.

Epigenetics has potential to lead us to the prevention of mental disorders by reducing risk that is formed through the intersection of our genes and the environments we are born into and in which we live and work.

In the light cast by epigenetics, we now have a scientific premise to affirm what was already generally but obliquely known – that environments contribute to the cause of mental illness. Therefore, this report "triangulates":

Mental health which underwrites productive capacity in a brain-based economy essentially a source of economic power, essentially a vehicle of potential historical discovery; **Epigenetics** through which to understand and target the interplay of environmental risk factors with genetic pre-disposition including stress and **Artificial intelligence** as a source of social, economic and individual stress **and** a scientific tool to improve the management of mental disorders across the lifespan.

This proposition opens-up the idea of preventing the risks of mental illness by changing, reforming and essentially "humanizing" those environments – such as the workplace – which produce chronic stress, often routinely.

Genetic studies have come upon new ways to "pry open" schizophrenia to uncover the biological mechanisms of this serious condition – conceivably, a turning point, in early detection, new treatments and even prevention. Studies have also found there are common variants among depression, schizophrenia and bipolar disorders.

Noting this, psychiatry's diagnostic guidelines (DSM-V) says "future (studies) will focus on mental illnesses as dimensions or spectrums of symptoms" rather than the more narrowly-defined and labeled disorders.

This approach represents a step away from the current subjective basis of diagnosing mental illnesses and 'try and error' treatments, introducing one day the means to diagnose mental disorders with the same precision as physical conditions.

Current labels of mental illnesses (depression, bipolar etc.) "do not represent valid disease entities," according to the US Government's mental health research funding agency. Mental illness is real but these classifications inadequately capture the experience and impact beyond subjectively-described symptoms and clinical observations. Society and science need biomarkers to strengthen our understanding of mental illness and our response clinically and societally.

To that end, we now know mental disorders are, in fact, brain circuit disorders and neurodevelopmental in nature starting in fetal or early post-natal life. In turn, this means that prevention can start early in life even before symptoms materialize.

Summary Part Four:

The Biology of the Human Brain

Brain circuits are key to how various parts of the brain produce thoughts, feelings, behavior, memory and creativity. This new knowledge produces greater understanding of the biological processes of mental illness, thus enhancing future knowledge of treatments and early interventions that really work.

The brain, of course, has physical properties and both physical and psychological impact. The underlying basis of mental illness will also be found in both biology and psychology. Going beyond the 'mental' part of mental disorders this report's DEPRESSION MATRIX demonstrates depression's links with heart disease and stroke, pain including arthritis, cancer, obesity, head trauma, diabetes, asthma, Parkinson's Disease, to name several dangerous depression co-morbidities.

Among those living with major mental illnesses, life expectancy is dropping. But what are we/they dying from? Pretty well what everyone else is dying from. Suicide is not the principal cause of early death within this population.

The "chain of complexity" connecting mental illness and other chronic disorders is examined in detail in this Report. It is said these cross-over influences are bi-directional. But are they? Another "link" in the chain of complexity is the tragic sway that loneliness has over mental health and wellbeing. Loneliness is a form of stress with a wide range of health consequences.

Summary Part Five –

Interpretations and Conclusions

The scale of the infusion of artificial intelligence forecast by a wide range of credible sources and proponents of the technologies associated with smart machines, augmented intelligence and autonomous robots, and other effects of the AI revolution, threatens widespread job loss and displacement. These profound changes will affect the mental health of a significant portion of society.

In turn, these changes will affect the productive capacity of a global digital economy that puts a premium on brain-based and not manual skillsets. At the same time, emphasis on cerebral functions as both the principal source and vulnerability of productive capacity in the era of artificial intelligence will highlight qualities of work that human beings are distinctively qualified to deliver.

The report underlines this essential fact: that the potential of artificial intelligence to disrupt employment and therefore the lives of people and families on such a large scale is, unto itself, a trigger for large-scale apprehension, fear and malignant worry about the future.

Therefore, how the AI revolution is rolled-out, introduced and implemented must be done in a way that provides maximum benefit to society. It must be gauged as a human event, not merely a technological revolution. The

nomenclature of artificial intelligence and genomics, in the case of synthetic biology, should be carefully managed and reviewed.

Designers and users of AI must be careful not to assign human-like descriptors to artificial intelligence because that leads to technology-like descriptors of people who constitute the workforce. The Report raises the question of whether the term "artificial intelligence" should be displaced before it is stigmatized.

Turning to genetics and epigenetics, good news on many levels: we now have the first basic molecular clues of the causes of mental illness and the news science of epigenetics – bridging the interaction between our genes and environments – is giving us new hope that knowledge of that interaction will open doors of possibilities to preventing mental illness before symptoms appear.

Recommendations:

In turn, that a 'science and business task force be created to determine how AI and epigenetics can be developed as a unified source of knowledge, research and innovation to set in motion an unprecedented international Plan of Prevention to end the disabling and deadly effects of mental illnesses.

That "stress" be the subject of intensified research to further delineate the basis of its impact on individuals in such varying ways and to examine how and why current cultural, economic and societal norms produce more intensive stress and thus risks of mental illness – even before the full impact of AI is felt.

That in Canada, a Royal Commission on "The Prospects of Human Development and Dignity in the 21st Century" be assembled to set forth a generational agenda on the human capitalization of a technology-intensive economy and the humanization of technology-intensive products and systems that are designed to replicate human intelligence.

That employers and their places of work be equipped with values/threats/mitigation standards and protocols with which to guide the introduction of artificial intelligence into operations in a manner least likely to cause employees and customers anxiety and tribulation of the nature discussed in this report.

Report on Mental Health in the Era of Artificial Intelligence

PART ONE

Human and Artificial Intelligence: Can We Keep Them Both Healthy?

The world is crossing an historic bridge spanning human and artificial intelligence and the result is a meeting *of two minds – one human, one not.* Can we keep both healthy? That is unclear.

The great scientist Alan Bernstein, President and CEO, Canadian Institute for Advanced Research, sees *"AI as such a powerful platform for analyzing data in new ways that its applications will extend into virtually every aspect of our lives and every area of research*."

"Together, the revolution in genomics and artificial intelligence," Dr. Bernstein says, "are forcing us to re-visit long-held, cherished views of what it means to be human." This frames the content of this report, an examination of both revolutions and their impact on the mental health and wellbeing of people.

The World Economic Forum offers a similar perspective: *"In a world where activities and decisions once undertaken exclusively by human beings will be replaced or augmented by artificial intelligence, profound questions arise as to what it means to be human."*

One thing it means to be human is living with mental illness and, conversely, using AI to stem the tide of the world mental health crisis. This report sees epigenetics and AI as a strategic unit with which ultimately to tame the global crisis in mental health.

The conditions we label as mental illness occur across the mainstream of life. Every living person is vulnerable. No exceptions. Public awareness of mental health and mental illness has risen sharply. And we have long since passed that threshold as a marker of success in "normalizing" discussion of these subjects.

"Now we need action, talking is not enough anymore," says a highly motivated, entrepreneurial mental health advocate Julie Durant of Vancouver, British Columbia. Julie is Founder of the "Year of the Mind" an event aimed at "solutions not talk", in Toronto later this year.

Where <u>will</u> "action" come from – where <u>is</u> it coming from?

Let us consider –aside from science -- the most fundamental sources of actions sorely needed – sources that also respond to Dr. Bernstein's thoughtfully provocative statement as to what it means to be human in the era of artificial intelligence. Fundamentally, mental illness will be conquered through human love, compassion, knowledge, discernment, courage, will, humility, self-awareness.

These are the tools of the human experience that appeal to "our better angels" as is often said.

And these are among the very qualities that give expression to our collective humanity dispatched one unto the other – human beings in the service of human beings, and in search of relieving the pain of mental illness on such a large scale as currently exists using all available tools including genetics -- specifically, epigenetics – and artificial intelligence itself (as noted above).

That said, artificial intelligence represents a quandary.

AI embodies both promise and peril (as is often declared by experts in the field) when it comes to mental health. It promises new tools to fight mental illness and the wellbeing of whole nations but, simultaneously, it will be – quite predictably – a man-made carrier of man-made stress, and, therefore, in its own right, a distinguishable source of human emotional distress and mental disquiet especially in workplaces, schools and in the home.

The vastness of the infusion of AI into society – as forecast by informed observers, pioneers in the field and real-time experts –predicts its disturbing impact in these terms. That is invasive change, possible chaos and dislodging uncertainty among societies already vulnerable to chronic stress and where 50% of the world population is lifetime symptomatic of mental illness.

The effects of AI will be heavily centered on working populations and families already stressed-out by the globalization of industries, job losses and the pervasive, addictive attributes of social media, on-line misinformation and all-day/all-night bad news generated by cable news via television and various digital platforms.

In all of this, dealing with AI is like wielding a two-edged sword: on one edge, the promise of technology that will do a substantial amount of good and, on the other, its intrusion upon our function as human beings. This Report is designed to bring this duality to the fore in terms relevant to brain-based mental health in a brain-based digital economy that puts a premium on cerebral skillsets

In Pursuit of a Great Goal

The report is not a scientific document, it is a document about science, a journalistically-styled text and sources are quoted on the spot. Where the author makes "editorial comments," that will be self-evident. This report connects a lot of dots and creates a universe of collated information and ideas that otherwise remain unlinked. Epigenetics and artificial intelligence illustrate this point.

Based on emerging and "known" scientific knowledge, and a higher level than ever before of public awareness of mental health as a common and pressing public concern, the author suggests we now have the premise for science and society to pursue – plausibly, and comprehensively – a great, audacious goal: t**he prevention of the destructive, disabling, deadly, distressing and disquieting effects of mental illness in the 3rd decade of the 21st century.** The guts of a prevention and cure scenario such as that mentioned earlier.

The settings for such a goal:

- The world's transition to a brain-based economy that, by definition, provides economic incentives for investments in brain-based mental health while accentuating, also by definition, the disturbing effects of mental illness on brain-based productive capacity in workforces across the world.

- The dawning of a new era of discovery in the field of genetics, epigenetics and brain science that could lead the way to ending the crisis in world mental health if – IF! – strategic research investments in these allied fields proves adequate and sustainable and the results actually reach the "clinical bench." A genuine concern.

- Clear base of scientific information that the environments that we, human beings, create, and are born into, and in which we live and work are instrumental in causing disease including mental illness. This, as we move more deeply into a time when chronic disorders have overtaken infectious disease as a pre-eminent world public health concern.

AI: Losing one's sense of self and place at work

AI may force 375 million people to switch occupations as its presence is felt in business operations and job markets across the world. The kind of stress this will produce is the kind that invades the individual's sense of self, sense of place, sense of purpose, producing effects that can deteriorate into the symptoms of mental disquiet, distress and, ultimately, a clinical illness.

Let us consider this. Artificial intelligence is likely to be a source of the kinds of stress that the National Institute for Mental Health has identified as a "Negative Valence System" for risk factors that can drive the development and onset of mental illness: fear, frustration, rumination, threat, anxiety and loss. It is fairly easy to see how job loss and displacement or the fear of them (on such a large scale) could have such an effect.

These specific risk factors contrast – and impose upon – the attributes needed for productive capacity in work environments that are suitable for a brain-based economy and development of brain-based skills including – as general skillsets in their own right - trust, fairness, job fulfillment, common sense and common decency.

Human Capitalization of the Digital Economy

Consulting giant KPMG, in its global analysis of mental health, concluded that "mental health development is economic development – important in a world built around human capital and knowledge." And, *ipso facto*, human intelligence. In that light, the mental health of employees – the key source of productivity in a brain-based economy - becomes part of the asset value of effective organizations. The important study of the Sears Company by Gallup years ago found that employee morale forecasts financial performance more accurately than traditional financial forecasts.

Yet, the Economist reported as far back as 1998: "Falling interest rates, collapsing confidence and sluggish activity command the attention of economic policymakers. Seen in people rather than countries or markets, though, the same symptoms cause much less of a stir. That's why there is little outcry about 300M people suffering depression around the world."

Jobs in the era of artificial intelligence demand cerebral not manual skillsets, the digital economy puts a premium on the cognitive capacity of people, so now is the time to seek incentives for employers to spend money on measures to support and re-train employees during a time of (projected) momentous change.

One tool proposed in this Report is a tax incentive through which (in Canada, as one jurisdiction) investments of this nature are tax-deductible at an enhanced rate, 1.25 times the actual amount spent. Alternatively, spending for these purposes could generate a tax credit.

There is precedent in Canada for this. Spending on salaries that qualify for research and development already generate an enhanced benefit over and above the actual spending on R&D equipment. In an economy where brain skills are needed to perform work relating directly to profitable and competitive operations, recognizing investments in those skills makes ample sense.

We might call this part of an overall concept called the "***Human Capitalization"*** of the brain-based, digital economy in the era of artificial intelligence. In this way, in this new era, the workplace might become a test bed for the introduction of public mental health principles in the AI era - education and prevention - which are financed or at least incentives by this new tax incentive.

PART TWO

Implications of the Revolution in Artificial Intelligence

Human vulnerability to artificial intelligence will likely be expressed by how the deployment of AI takes place and whether it is a serious affront to *"who I am, my self-worth, my self-esteem, whether it generates emotional and physical isolation, rumination, deep frustration."* Whether, like mental illness, AI digs into the inner self with invasive doubts, uncertainty and fear:

In the face of AI, what does it mean to be human – TO ME?

"O my God-o-my God, o-my God." Joseph Schildkraut, professor of psychiatry at Harvard Medical School, is pacing across a darkened room in the Massachusetts Mental Health Centre, wringing his hands. "What's going to happen to me?" Dr. Schildkraut is not symptomatic and desperate. He is demonstrating the inner turmoil caused by depression.

Deep Uncertainty

Nobel Laureate Dr. Eric Kandel tells us that "preserving or losing the self" is crucial to all human beings: "self-awareness leads us to why we exist - one's sense of purpose and sense of being present." In fact, this is what mental illness undoes. This is what AI could lead to through deep employment uncertainty and through the bloodless or careless infusion of artificial intelligence into the work lives of hundreds of millions of people.

The loss of self, loss of purpose, a fading personal identity. In effect, the stuff of depression, anxiety and for some, the stuff of suicide. On this basis, we can see that artificial intelligence – specifically its massive injection into our lives - contains a roster of "causes and effects" and these will play out according to the wisdom or foolishness with which AI is introduced in full measure.

For example:

- If AI is "injected" like a bulky drug into the mainline of society, the economy and the workplace without planning, transparency and training for those directly affected, if it happens like social media arrived in the late 1990s and 2000s -haphazard, a blizzard of one-off inventions and built-in obsolescence via products designed to attract addictive use by people - then human beings must be encouraged to protest this and protest it hard.

- If the apparent motive behind AI is discerned by employees to replace them, without creating new employment opportunities, then AI will be unwelcome and will profoundly worsen the "stress" experience of employees who work alongside these machines and are expected to see them as co-workers, thus losing their sense of place and sense of self.

- If AI deepens the effects of distraction, isolation, fear and uncertainty which feeds mental unrest and distress, then artificial intelligence will damage society.
- If robots give the aging and aged compassion and companionship and relieve human beings of this "duty," machines will become human to the lonely and alone.

- If AI replaces health care workers to cut costs, it is misplaced. If AI is trained to produce racial bias or think violently, then its own "brain" will be troubled.

These statements are more cautionary than predictive. At the same time, even the spectre or apprehension of AI's impact on the lives of people can, over time, affect mental health and wellbeing. Therefore, the prospects, promise and peril of AI must be communicated and transparently planned for. Clarity of purpose and clear boundaries between the superiority of the human being and the secondary, support role that technology performs must be struck in bold relief.

Global AI Pioneer Speaks Out

Kai-Fu Lee believes that civilization will soon face an AI-induced crisis that will disrupt our economic and political systems and even cut to the core of what it means to be human in the 21st century. "In short, this is the coming of crisis of jobs and inequality", he says, adding, "our present AI capabilities can create a super intelligence that destroys our civilization. But my fear is that we humans may prove more than up to that task." Stephen Hawking said precisely the same thing in his last book.

THE TAY DEBACLE

Scientists at Imperial College in London say that AI has the potential to demonstrate it has a "mind", and there is the potential for "these minds to become dysfunctional or for artificial intelligence and robots to suffer from mental illness". In 2016, Microsoft conducted an experiment by releasing a Twitter chatbot, called Tay based on an opaque deep-learning algorithm. Twitter trolls completely corrupted Tay, essentially turning it into a racist, misogynist and Hitler devotee.

Microsoft launched Tay as an experiment in conversational understanding. According to Microsoft, the more you chat with Tay, the smarter it will become. The goal was to teach it to engage people through "casual and playful conversation". But only two hours into the experiment, Tay began insulting humankind. Just three hours later, Tay is ready to do away with humanity altogether. Microsoft ended its experiment after less than 20 hours, promising to make some "adjustments" to Tay. Scientists said, not all of Tay's responses can be explained by the garbage in / garbage out axiom, and just as we may never know what makes a person turn down a dark path, Microsoft may never know what went wrong with Tay.

An AI-Eye to the Future

Noting the escalating rise of artificial intelligence, the World Economic Forum's 2018 Jobs Report looked at 20 economies and 12 industry sectors and advises business to be ready for:

1. High-speed mobile internet, artificial intelligence, big data analytics, and robotic technologies that are set to "spearhead adoption of new technologies through 2022."
2. Job roles based on distinctively human traits growing – such as service, sales, marketing and culture, organizational management and innovation.
3. Decline in the number of "total task hours" done by humans slumping from 71% to 58% with 42% of these tasks performed by machines or algorithms by 2022.
4. Significant job dislocation, existing "job roles" becoming obsolete but a "net positive outlook" for jobs with "newly emerging occupations."

One report put it this way: "AI, it seems, has come of age, feasting on the vast data sets generated by our hyper-connected world from the outpourings of social media to warehouses of medical reports and meteorological data points, the machines are getting smarter at a dizzying rate."

This feasting pounced upon the personal data of people who thought they were the consumers of social media products, services and fads, but were/are, in effect, the consumables. And that view comes from within Google itself.

Sixty nine percent of respondents to one survey (PEGA) "expect the term "workforce" to eventually encapsulate both human employees and intelligent machines" while 64% believe AI will allow more varied roles for employees. The Royal Bank of Canada says more than 25% of Canadian jobs will be heavily disrupted by artificial intelligence.

The World Economic Forum has launched an initiative to help shape "the future of the Digital Economy and Society". One area of concentration is the "digital transformation of industries" and fostering values such as trust and resilience.

Accordingly, big data analysis, web and app markets, machine-learning and augmented and virtual reality are among the technologies that most companies will adopt by 2022. Humanoid robots, underwater robots and biotechnology are least-likely to draw investment.

A report by researchers at Memorial University in St. John's, Newfoundland, projects that by 2025, there will be more than 50 billion devices connected to the Internet. This foretells disruption in a wide range of industries including offshore activities.

Quoting the Memorial study, McKinsey has estimated that digitization of both technical and non-technical work may automate 60 to 90 per cent of routine manual tasks in traditional manual jobs.

4th Industrial Revolution

Another new report from the World Economic Forum – "The Future of Jobs" – says, "creativity will become one of the top three skills that workers will need by 2020". Creativity is a cognitive function, a brain skill and a principal target of the most disabling of all health problems afflicting working populations – depression, blood pressure, anxiety.

As the era of artificial intelligence takes hold, the Forum foresees sweeping changes to the nature of work powered by a "Fourth Industrial Revolution" and the advent of what the CEO of IBM calls "new collar jobs". The Forum forecasts that globally up to 375 million workers may need to switch occupational categories. China, India, US, Canada, Mexico, Germany will be among the hardest hit, in that order.

There is a consensus that the kinds of work that AI will take over might be classified as repetitive labor, scripted customer service and telemarketing, narrow fields of work like banking services, and jobs with no face-to-face human contact. At the same time, the WEF also highlights the value of what human beings, not machines, offer in the form of *creativity, understanding, handling complexity, adapting to new environments and, essentially, unscripted encounters requiring instinctual, discrete behaviors.*

Each of these requires healthy cognitive functions, and each demonstrates that the minds, not the backs, of employees do the heavy lifting for business in the 21st century. Anders Sandberg, Oxford University "Future of Humanity Institute". is quoted as saying that, "if your job can be easily explained, it can be automated, if it can't, it won't."

IBM Chief Executive Ginni Rometty says the "skills gap and job insecurity" relating to artificial intelligence (and automation) are real." She says, "when we talk of a skills crisis, I really do believe that 100% of jobs will change."

The crisis, though, can be overcome. Ms. Rometty told the World Economic Forum at Davos that she wants to see the development of a new education and career model, new collar jobs, not blue or white. This means, she says,

investing in skills development and responding in real time to changes in present and future jobs. Without this, she forecasts social unrest.

At Davos, France's Minister of Labor, Muriel Penicaud, said her country was giving employees 500 Euros a year to choose training of their own choice. "Today, access to capital is easier than access to skills," she said, urging "pro-action.

Meanwhile, the Canadian Institute for Advanced Research and the Brookfield Institute for Innovation and Entrepreneurship have built a roster of experts to measure the impact that automation is likely to have on Canadian jobs.

Social Climate Change

In the face of all this, it is predictable that chronic stress will be intensified by the vast infusion of AI into our lives. Stress is the combustible connection between the individual and the social and economic environment in which they live and work. On this basis, stress can predict mental distress and disorders.

The Canadian Mental Health Association has captured that dynamic in these words: *"Mental health is defined as a congruent relationship between a person and surrounding environments and systems … where the requirements and resources are congruent with needs and capabilities of the individual."*

The focus is on interaction, the exchange between persons in a given surrounding acceptable and beneficial to both. Any understanding of mental health and personal wellbeing must place employment in a context which includes the wider social experience of people."

Stress can be harmful as it accumulates, outside of one's control such as unforeseen and perpetually tight deadlines, excessive worry about tomorrow, isolation from the team or the group, unrelenting peer pressure. Research by the Ontario (Canada) Institute for Work and Health found that job stress encountered "on the margin" – that is, at the end of the day, and taken home – is as big a threat to cardiac health as smoking.

AI will be a synthesizer of social-climate-change, and while it can't melt icebergs, it can melt human resilience and wellbeing and, like the other kind of "climate change", it is man-made, preventable and can be mitigated by remedial measures.

The late Fraser Mustard, founder of the Canadian Institute for Advanced Research, and a leading world authority on the determinants of health, said one of the key mechanisms of stress was "the nervous system and the immune system in direct communication."

Thus, changes in the nervous system, including one's psychological sense of wellbeing, could affect an individual's defence (against disease) through changes (imposed by stress) on the body's immune and hormone systems – elevating one's susceptibility to cardiovascular disease, cancer, depression, anxiety and allergic reactions."

Work Climates That Predict Lost Work

Mental stress in the era of artificial intelligence – like AI itself – is largely the creation of human beings.

Put another way: AI will be a carrier of man-made stress among working populations and their families. The Chief Scientist of Quebec, Canadian neuroscientist, Dr. Remi Quirion once called the future discovery of why human beings are thus affected by stress the "Holy Grail" and pointed to the need for scientific, social and economic inquiry into the impact of the proliferation of human stress.

Scientists at Harvard University surveyed a wide range of businesses in a cross-section of industries and found that the strongest predictors of days lost at work are "psychosocial" work climates. The term "psychosocial" can be taken to mean the emotional whip-lash created by gossip, harassment, bad management practices such as micro-managing and uneven work distribution, and even bullying - all of which can diminish productive capacity and the asset value of human capital in a brain-based economy.

In an economy that puts a premium on cerebral skillsets, stress is a workplace health and safety hazard as dangerous as unsafe equipment, sloppy work sites and polluted air. Dismantling these sources of stress means changing attitudes and behaviors among executives, managers and supervisors. Bell Canada and the Government of Canada (as an employer in its own right) have both incorporated fostering mental health in the workforce into the job performance standards of senior executives.

Stress Epidemic Commands CEO Attention

In the face of the stress epidemic, CEOs are being called upon to take on a greater leadership role in reducing the mental health burden among working populations. We note the available of CEO Guidelines for Mental Health and Productivity at www.mentalhealthinternational.ca and www.targetdepression.com which would be useful in this context.

Describing "unsettled, dangerous times" for employers and employees alike, the Guidelines say, "business has a significant stake in helping to promote and protect the mental health and wellbeing of their employees." The Guidelines encourage CEOs "to give your employees every chance to learn about and discuss mental health issues without fear or reluctance." The Guidelines say "defusing myth and misperceptions of mental illness is ongoing work."

The CEO Guidelines, in turn, beget what we call the "New Hard Skills of Management" to rid the contemporary workplace of a range of unhealthy management practices including unreasonable demands, withholding employee discretion, rejecting "out of hand" workload concerns, randomly changing priorities, the treadmill effect at work, and perceived unfairness on a perpetuated scale.

These management practices constitute the breeding ground for chronic job stress that can affect brain function similar to how a serious knock on the head can inflict a concussion. To counter corrosive management practices, the New Hard Skills of Management embody the building blocks of psychological health and safety at work.

These include organizational objectives that are well-understood by employees; distribution of work and job skills that are well-matched; cultures of resilience that replace cultures of angst and tension; and job fulfillment is part of the employment deal.

The New Hard Skills of Management will be needed to lift up and render "ideas, inclusion, trust, loyalty and motivation as business tangibles in the era of artificial intelligence. Mental Health International has developed a construct to serve as the "fuel source" of organizations that aim to succeed in an intensively competitive global, digital, brain-skilled economy.

BRAIN HEALTH + BRAIN SKILLS = BRAIN CAPITAL: Brain Health: a state of employee wellbeing that delivers productive capacity and innovation in a brain-based economy. Brain Skills: the principal business asset in a global, brain-based digital economy where most new jobs demand cerebral not manual skills. Brain Capital**:** investments in employee brain health and brain skills in a work environment where psychological health and safety and produces a return on those investments.

Healthy Workplace in The Era of AI

Let's recall the findings of Statistics Canada some 20 years ago as computer-based technology swept just about every place of work – emails, voicemails, electronic receptionists – none of this actually improved productivity in Canada because it happened in a vacuum.

Employers invested in the hardware, software, systems, installations and eliminated a whole generation of front-line and "support staff" jobs while ignoring the need for training of employees who were supposed to improve output with this new technology. Cost structures shrunk as intended, but productivity did not improve.

Will history repeat itself? Now, we find ourselves in a brain-based, business economy where adjustments in skills development and the nature of work will be necessary and where:

- Employee "thinking" does the heavy lifting for employers and innovation is – literally - a deliverable of mental health in the workplace; neither technology nor pricing, according to Harvard management legend Dr. Michael Porter, are the principal source of competitive or comparative advantage for companies competing in this digital economy, **but people are.**

- McKinsey and Company executives ask whether AI will be the vehicle through which "we can look forward to vast improvements in productivity, freedom from boring work and improved quality of life or … should we fear threats to jobs, disruptions to organizations and strains on the social fabric. "

McKinsey goes on to explain various workplace fundamentals in the era of artificial intelligence. One especially caught our attention: the future of creativity at work. "Creativity and sensing emotions are core to the human experience and are difficult to automate." That said, right now, just 4% of work activities across the US economy require creativity and "sensing emotion" at a median in level of human performance."

In the era of artificial intelligence, in a brain-skilled economy, the distinctions between a healthy and unhealthy workplace are observable: **Healthy Workplace**: fairness, respect, recognition, appreciation, job clarity, reasonable demands, inclusion, common purpose. **Unhealthy Workplace**: frustration, distrust, anxiety, fear, tension, low morale, low commitment, chronic job stress and, classically, bad management and obsolete practices.

And there is a broader overall point to all this: the strength of the business case for investing in mental health is mirrored (in reverse) by the over two trillion dollars a year in lost productivity for not doing so adequately. The workplace can become – and among some employers, is becoming - a venue for the prevention of mental health problems through education, early support and reducing the sources of chronic stress, probably, ultimately, the key to the door of success in this realm.

Dr. Danielle Fallin, Head of the School of Mental Health at Johns Hopkins University and Dr. Ellen MacKenzie, Dean of the Bloomberg School of Public Health at Hopkins, make this point: *"Improvements in workplace mental health transcend work life and affect our home life, family and friends. If we fail to act when the findings of sound science, logic and economics intersect, then what does the future hold? The need for workplace mental health solutions is profound. Empirical evidence validates that statement.*

Neuroscience and AI for Mental Health

Can artificial intelligence play a role in bringing mental health in the workplace to higher standards of promotion and protection. There are signs this may be the case.

Brain projects are underway in Canada, US, Israel, Europe, Asia and South America. One of Canada's most innovative and articulate neuroscientists, Dr. Anthony Phillips, Director of the Mental Health Institute at the University of British Columbia, once called this the "Quiet Revolution" in neuroscience because "it is happening but no one knows about it."

The "Kavli Foundation" is leading discussions of ways in which the international community could work together to advance brain research, including the development of standards and ethical guidelines for brain research, funding mechanisms to support international collaborations and training platforms that facilitate the sharing of large experimental data sets and powerful brain research technologies.

These platforms could include virtual research centres, web portals for data storage and analysis, and facilities where scientists can access specialized research tools. All very thought-provoking and inspirational. At the same time, the future of psychiatry is being re-cast by the advent of neuro-technology and the brain-machine interface. Science Direct reports on the expanded possibilities of neuro-prosthetics and neuromodulation to treat mental illness.

Notably, the European Brain Council, a progression force in pushing governments to invest in brain health calls upon the European Commission to come up with a pan-European Plan for Brain Health. A bold significant statement.

AI applications to meet the mental health needs of human beings is examined in the book, "**Artificial Intelligence and Behavioral and Mental Health Care."** Dr. David Duxton, research scientist at the Naval Health Research Centre in San Diego, California and an Associate Professor of Psychiatry, University of Washington in Seattle, wrote the book's introduction. Following are a few extracts:

Mapping the Human Brain

- *There are several research programs underway to capitalize on supercomputing advancements to map and model the human brain.*
- *The Blue Brain Project in Switzerland – is creating software to model the brain at the molecular level to simulate a biologically realistic model of neurons.*
- *In the U. S., a $1 billion investment in brain mapping is designed to create a functional map of neural networks of the human brain.*
- *Computer systems that simulate the human brain have the potential to improve understanding of both normal and abnormal human brain functioning.*

Modeling Psychiatric Illnesses

- *One future possibility: modeling psychiatric illness and to test models of the course of development and outcomes of treatment.*
- *University of Texas scientists are modeling the development of schizophrenia on a super computer to simulate the excessive release of dopamine in the brain.*

The Nature of Consciousness

- *Building machines with human general intelligence has the potential to help us learn more about the mind of AI and even the nature of human consciousness itself.*
- *Question: would an artificial human brain develop a subconscious mind, unwanted thoughts, and repressed memories?*
- Research is happening on human-robot interaction in healthcare settings and what people prefer in using intelligent machines for healthcare purposes.
- Much research needs to be done to (figure out how to make) intelligent machines (to interact with people seeking mental health care).

Sight, Sound, Touch and Smell

- *AI called "machine perception (will) give computers the capacity to recognize images, sounds, touch, and even smells" (to enhance interactions with people.)*
- *Science is also focusing on the ability of machines to detect, classify and respond to human emotion.*
- *(Computer-based) "virtual reality can be used for clinical assessment and treatment decisions concerning psychological disorders.*
- *Virtual human systems have been developed and tested to provide healthcare information to improve medication adherence to treat schizophrenia.*

Machine-Brain Coupling

- *Coupling AI technology directly with the human brain through invasive or non-invasive means may permit treatment of non-congenital blindness; improve general cognitive abilities; restore function to a damaged brain; expand the benefits of telehealth and, through sensors and biofeedback, customize clinical services.*

- Google Accelerated Science is using artificial intelligence to help make diagnosing diabetic retinopathy easier by accurately interpreting retinal scans, possibly saving the eyesight of millions in India.

The University of Toronto has put into place a Chair in Robots in Society to help the elderly maintain their independence through and with the help of robots. "Augmented reality" technology --- (described as the super imposition of the elements of a virtual world upon the real one) --- is being developed to use in therapy for children with autism and/or for treating malignant melanoma. (Fraunhofer Institute, Germany)

IBM reports on new research using AI and machine learning algorithms to identify "instances of schizophrenia with a 74% accuracy". The research also indicates the capability to predict severity. A new discipline, "computational psychiatry" will help clinicians "access and treat patients more quickly". Interestingly, computational psychiatry can be seen as a tool for psychiatrists to move past reliance on "subjective" evidence of the presence of mental illness.

AI and Mental Health Innovations

AI instruments are being developed to improve access to early detection, improved care and treatment outcomes of mental ill health. For example, **Canadian Daniel Martz, CEO of Equinox**, is using machine learning and artificial intelligence (**ML/AI**) programs to expand access to cognitive and mental health therapy through virtual means 24/7 in Canada's both official languages – a first.

This then feeds into a database that will strengthen clinical decision-making, Mr. Martz says. The innovation will be used to monitor those with other chronic disorders, opening up the possibility of deploying AI to help manage co-occurring depression and diabetes, cardiovascular disease and other co-morbid conditions.

California-based **MINDSTRONG,** co-founded by the former Director of the National Institute for Mental Health, Dr. Thomas Insel, has introduced technology that tracks biomarkers of mental illness digitally.

MINDSTRONG describes its innovation as "augmenting and extending existing care models" through a smart phone app that identifies individuals who may need immediate attention. Among other things, it provides "biomarker loading" to signal mood changes, insomnia, lethargy, eating problems, guilt feelings, concentration problems, psychomotor issues and even suicidal thoughts, connecting the individual with a mental health professional who communicates via the Smart Phone in real-time.

A separate innovation called **MIND.ME** "ambiently monitors behavior online as well as the user's interaction with the world and the people around them." Executive Chairman of the company is Patrick Cashman, former CEO of Lundbeck Canada and its Medical Director is Dr. Roger McIntyre, an innovative scientist-physician who sits on the board of directors of Mental Health International.

This technology assists in the "diagnosis and prediction" of a depression episode and creates a "circle of trust" among friends and family members who may be contacted when the signs of a depression episode appear. Further, the user will be able to see their current mood compared to the same time last year with the same data going to physicians and caregivers.

The focus, widely, is mapping brain circuitry so as to understand how dysfunction, disorder and disquiet happen and how this can be resolved." Other developments illustrate the promise of artificial intelligence to elevate the prospects of difficult recovery. For example, Google Accelerated Science is using artificial intelligence to help make diagnosing diabetic retinopathy easier by accurately interpreting retinal scans, possibly saving the eyesight of millions in India.

AI Tidal Wave

Further, in the face of change driven by AI, Richard Baldwin, economist and author, warns that "this international talent tidal wave is coming straight for the good, stable jobs, plus that have been the foundation of middle-class prosperity – North America, Europe and other high-wage economies. And this anxiety can explode.

The questions that emerge: are these warnings "legit" or irrational? Either way, even if the hype is unwarranted, the worry about jobs is real. Media reports – including an HBO special in early 2019 - have already reported on "the collapse of the white, high school-educated working class in the US and the pathologies that accompany the decline."

The UK's Science and Technology Committee acknowledges that technology is going to disrupt the way people live and work, so authorities are attempting to understand to what extent it will happen. "While we cannot yet foresee exactly how the World Economic Forum's "fourth industrial revolution" will play out, we know that gains in productivity and efficiencies, new services, jobs and improved support in existing roles are on the horizon, alongside the potential loss of well-established occupations."

From the Harvard Business Review, we hear again from Dr. Michael Porter who says, "augmented reality technology is poised to reshape how we learn, make decisions and operate in the physical world." The HBR editor adds this: "Though still in its infancy, the AI technology is already being used by Facebook, Amazon, GE, US Navy and Mayo Clinic to achieve improvements across several measures of performance."

National Strategy on AI

The Government of Canada has embarked upon a national strategy for artificial intelligence. The Canadian Institute for Advanced Research (CIFAR) has been commissioned to produce this strategy and according to CIFAR, a "revolution in the field of artificial intelligence" is underway, creating computers that "think more like us." CIFAR, in fact, has played an historically significant role in artificial intelligence research in Canada and around the world, enabling some of the fundamental breakthroughs in the field through its Learning in Machines & Brains program.

In this light, CIFAR will explore the ways that AI will reshape our society and how we should respond. CIFAR Fellows are "studying the social underpinnings of wellbeing in numerous contexts, such as educational attainment, mental health and personal happiness." Computers that are better at understanding and learning from the real world could revolutionize medicine, industry, transportation, natural resources, healthcare and the arts, oil and gas production.

According to CIFAR's Institute's Annual Report: "The result will be computers that are not only powerful but intelligent and that will be able to do everything from conducting a casual conversation to extracting meaning from databases of information." Computers learning from the real world could revolutionize medicine, industry, transportation and our day-to-day lives and, in fact, CIFAR researchers are using deep learning to identify genetic contributors to conditions such as autism."

CIFAR CEO, Dr. Bernstein calls for steps to "combine AI thinking with new ways of medical diagnosis, new materials for energy harvest and storage and predicting the emergence and tracking of new viruses such as the ZIKA and Ebola viruses. Last year, top academic researchers were named to AI Chairs as part of the $125M Pan-Canadian AI Strategy that will help maintain Canada's leadership in artificial intelligence research.

Quebec Leadership

Quebec's Chief Scientist, Dr. Remi Quirion, long-time mentor to and supporter of the author, took one of the most significant steps toward the advance or mitigation of the societal effects of artificial intelligence in May, 2018. He issues a "call for Proposals" that led to the creation of the International Observatory on the Societal Impacts of Artificial Intelligence bringing together universities, colleges, research centres, governments and non-government institutions, business and other groups across the world.

The Observatory is set to examine "AI and digital issues of concern to all spheres of society , the impacts on individuals and organizations and communities . and to suggest solutions and provide directions to decision-makers." More than 16 researchers will join "this new scientific hub." Leading this effort is Dr. Lyse Langlois, Director of Laval University Institute of Ethics and professor of industrial relations.

Professor Langlois describes her mission this way: "We will work together to improve understanding, better inform the public and help decision-makers as they grapple with the huge challenges this fast-growing field poses in terms of employment, health, education, technology, security, democracy, justice and ethics."

The Vice-Rector of Research, Creation and Innovation at Laval, Dr. Eugene Brouillet, adds this: "The challenges of AI and digital technology know no borders and demand global study and decisive action. The entire international research eco-system in this explosive new field have a role to play in the Observatory." McGill University in Montreal is also a partner in the Observatory and has assigned ten scientists to this work.

Meanwhile, Facebook is opening a new Artificial Intelligence Research Lab in Montreal to be led by Dr. Joelle Pineau, Co-Director of McGill's Reasoning and Learning Lab and she is one of the McGill researchers whose work focuses on social applications particularly in robotics in health, transportation and language processes.

Government Directive on AI decision-Making

Meanwhile the Government of Canada has instituted, as of April 1, 2019, a "Directive on Automated Decision-Making" designed to "ensure that automated decision systems are deployed in a manner that reduces risks to Canadians and federal institutions and leads to more efficient, accurate, consistent and interpretable decisions made pursuant to Canadian law. "One interesting assurance that the directive seeks: " an automated decision system allows for human intervention … when appropriate."

The Directive is part of what the Government of Canada's Chief Information Officer Alex Benay describes as the government's strategic investment in the Canadian AI eco-system. He says investments such as this are needed as "AI has emerged as disruptive technology that is rewiring the way we interact with the world. - technology that is becoming more pervasive and will have profound impacts in the years to come. "

Mr. Benay refers to the government's Cdn$125M investment in the Pan-Canadian AI Strategy and $950M for what he describes as a "superclusters initiative" to generate cutting edge research. He says the Government also recognizes that AI offers efficiencies in service delivery but also poses risks unless its use is "governed with clear values, ethics and rules." Thus the Directive on Automated Decision-making in the Government of Canada which will be accompanied by an "algorithmic assessment" to spell out ethical responsibilities involved in using AI.

A discussion paper was authored for the G7 Multi-Stakeholder Conference on Artificial Intelligence on December 6, 2018 by a team representing the University of Ottawa, University of Tokyo and the Canadian Institute for Advanced Research. The paper spelled out the need for "accountability in artificial intelligence but there is no consensus a among the broader community as to what an (accountability) toolkit would look like."

The Paper – requested by the Government of Canada – says (calmly) that "as with any new technology, we are learning that deploying AI beyond the lab can result in harm to individuals and societies." Potential "harms and challenges" include the effects of biased data sets in creating discriminatory applications of AI, the difficult-to-control behavior of deep learning systems which function like a "black box" and people "over-trusting AI and leading to physical and mental harms."

"These systems are opaque and coupled with their potential use in critical high-stakes, decision-making context (such as judicial reasoning, war-fighting, financial transactions), their potential impact is significant."

"For example, a routine software update to a traffic routing algorithm controlling an automated and connected mobility system could quickly redistribute risks among millions of people within the system. Determining who ought to face greater risks within a mobility system is a weighty task with broad implications and the process (and responsibility) by which we make that decision and its consequences, must be determined."

Among the roles for accountability, the authors of this paper point to corporations and other data owners to ensure appropriate levels of human control in the design and use of automated (algorithmic) decision-making. As for the G7 itself, it is looked upon for funding for research, endorsement of a "new principles" declaration, working groups to share best practices in government and support of national, country-level initiatives in support of AI transparency and ethics.

The Discussion Paper says "anticipating and addressing these potential risks is urgent. One pressure point for this is the need for international cooperation and accountability." AI is portable across borders, it is developed and deployed in multiple jurisdictions and in ways that cross international boundaries and cultures. And movement of digital assets is difficult to constrain." The need for research in establishing standards of accountability for AI is far-reaching --- that is, from explaining AI and managing bias to policy, ethical, monitoring and legal issues. (And, one would add, the impact on the health, wellbeing and integrity of the human person).

The Brookings Institute gives us guidance in this area. Its report on the effects of AI and automation on "people and places" calls for promoting a constant learning mindset, reskilling incumbent workers, fostering uniquely human qualities, future-proving vulnerable regional economies, reducing hardships for workers who are struggling, and focusing on AI-change as tasks not whole jobs to be taken over by machines.

Brookings: "Almost no occupation will be unaffected by technological change in the AI era. Some of the most vulnerable jobs are those in office administration, production, transportation and food preparation. High risk jobs will be those with over 70% of their tasks likely to be automated."

Meanwhile, we propose in this Report that a **"values, threat and mitigation**" process and protocol be developed for workplaces, specifically: an ***'AI Values Affirmation Principle'*** – establish and affirm the values that will guide implementation of AI; an ***'AI Threat Measurement Standard'*** – evaluate the sources of fear, apprehension and chronic stress produced by the prospect and reality of introducing AI into the workplace and an ***'AI Mitigation Process'*** - do and undo what needs to be done and undone to mitigate these threats to the values guiding AI implementation.

On other fronts:

Pledge for World Safety

Other concerned citizens and groups are stepping forward to support containment of uncontrolled and uncontrollable AI technology. This past year leading AI companies and researchers agreed to take concrete action against existential threats posed by artificial intelligence, including a vow never to develop "killer robots" (lethal autonomous weapons), a pledge signed by over 160 organizations from 36 countries and 2,400 individuals from 90 countries.

The University of Montreal brought forward "principles and recommendations" in the form of the "Montreal Declaration for Responsible Development of Artificial Development" with three core objectives: develop an ethical framework for the development and roll-out; guide the digital transition so everyone benefits; and open a national and international forum for discussion to achieve equitable and inclusive AI development.

The Declaration contains ten principles, among them, that AI systems must permit the growth of the wellbeing of all sentient beings (meaning people); all systems must respect the autonomy of people; and accommodate privacy, intimacy, democracy, diversity, responsibility."

The "Institute for Life" pledge recognizes that Artificial intelligence (AI) is poised to play an increasing role in military systems. At the same time, there is an urgent opportunity and necessity for citizens, policymakers and leaders to distinguish between acceptable and unacceptable uses of AI".

In a dramatic development, based on a $100 million gift, the University of Toronto is creating Schwartz Reisman Innovation Centre and the Schwartz Reisman Institute for Technology and Science. These institutes will aim to advance artificial intelligence and address the ethical and societal implications of artificial intelligence and other emerging technologies," as reported in a full-page ad appearing in the New York Times.

European Ban on Weapons - The European Parliament passed a resolution on September 12, 2018 calling for an international ban on lethal autonomous weapons systems (LAWS). The resolution was adopted with 82% of the members voting in favor. Among other things, the resolution calls on its Member States and the European Council "to develop and adopt, as a matter of urgency, a common position on lethal autonomous weapons systems that ensures meaningful human control over the critical functions of weapon systems, including during deployment".

The resolution also urges Member States and the European Council "to work towards the start of international negotiations on a legally binding instrument prohibiting lethal autonomous weapons systems. Chancellor Merkel of Germany called for "ethical standards in artificial intelligence and genetic engineering as well as the handling and ownership of data.

Clearly, the world is at a point-in-history that will lighten or darken the way for nations and communities across the world.

Social media is now drawing government attention to rein-in the unintended or ignored consequences of a wide open web available to human anger, unrest and fear on an unbridled scale. EU countries are developing controlling regulations and the Government of Canada is looking to dampen the capacity of social media to project hate and egregious misinformation into the social and political fabric of this durable democracy.

Asilomar Principles

In early 2017, a broad coalition of AI leaders signed the 23 Asilomar AI Principles, the first of which says that, "the goal of AI research should be to create not undirected intelligence, but beneficial intelligence". The Principles are the most widely adopted effort of their kind, having been endorsed by AI research leaders at Google DeepMind, Google Brain, Facebook, Apple and Open AI. Signatories include the late Stephen Hawking and more than 3,800 other AI researchers and experts.

The Future of Life Institute says this: "Profound societal impacts of AI are no longer a question of science fiction but are seen in many quarters from facial recognition technology to drone surveillance and the spread of targeted disinformation campaigns. Advances in AI are helping to connect people around the world, improve productivity and expand human insight. But AI may pose safety and security threats, exacerbate inequality and constrain privacy and autonomy."

New norms are needed around trust, security and the common good. The Future of Life Institute, among others, advises that "risks posed by AI systems, especially catastrophic or existential risks, must be subject to planning and mitigation." And it warns "AI developers not to cut corners at the expense of safety; if an AI systems cause harm, it should be possible to know why; the goals of "highly-autonomous" systems must be aligned with those of people. The New York Times reports that "without humans, Ai can wreak havoc, citing Amazon's AI-driven HR "software" designed to surface the best job candidates "but ending up biased against women".

On Other Fronts

Robots will help doctors to deliver medical care in the far north. CIFAR researchers, we are told, are using deep learning to identify previously unknown genetic contributors to conditions such as autism. The institute is working with the Brookfield Institute for Innovation + Entrepreneurship, which was launched in 2015. The two groups have built a roster of experts to measure the impact that automation is likely to have on Canadian jobs. CIFAR has also partnered with government and community groups to explore ways of promoting and disseminating digital literacy with a focus on underserved communities.

The Brookfield Institute aims to "demystify the core capabilities of artificial intelligence and find new ways for AI to promote public interest" and "understand future skill demands across Canada in an innovation-driven economy." The vehicle for this: Canada-wide "AI Futures Policy Labs" to promote informed and thoughtful discussions across Canada about the future of AI technology, its impact on society and public policy actions needed to mitigate risks and maximize benefits.

PART THREE

Implications of the Revolution in Genomics, Genetics and Epigenetics

A discussion of the implications of artificial intelligence for the mental heath and wellbeing of people is incomplete without reviewing these other topics as a source of considerable interest as both a risk to the basic human-ness of birth and life and as factors relevant to the quality of life people can anticipate. All of which – through life – bears upon the health and function of the human brain.

While the terms "genomics" and "genetics" are often used interchangeably, there are differences. Genetics is the study of specific genes or parts of genes with a known function. Essentially, the study of hereditary. Epigenetics, in lay terms, focuses on the interaction between our genes and the environments we are exposed to during birth and through life. From this interaction, disease occurs, and may be predicted and mitigated.

In 2013, Dr. Daniel Weinberger, Director of the Lieber Institute at Hopkins in Baltimore, told our 5th US/Canada Forum on Mental Health and Productivity in Toronto: "*Genetic discoveries represent the first absolutely objective clues as to what mental illnesses are at a very basic cellular level by which we might be able to predict and ultimately prevent individual risk status."*

Dr. Steven Hyman says that investments in genetics are important and timely. "Well-designed human genetic studies, carefully interpreted, are proving a direct route to elucidate psychiatric disease mechanisms. " This, he says is "a critical step toward the significant goals of advancing biomarker discovery and new, effective therapies".

Spectre of Unintended Consequence

Meanwhile, Genomics is said to be the study of the entirety of an organism's genes (the genome). This includes studies of DNA-sequence data developed for these purposes which can identify variations that affect health, disease and drug response. Synthetic biology is a branch of genomics which, like artificial intelligence, has been branded as both promising and perilous.

Synthetic biology encompasses tools and methodologies to write DNA, contrasting the traditional methods to read and sequence DNA. There are ethical questions embodied within fields of study including synthetic biology and genome editing. At the heart of synthetic biology is the quest to solve problems. Ontario Genomics touts science as a way to fight the Ebola and Zika viruses, overcome food shortages, even combat climate change.

Interesting to note, just as in the field of artificial intelligence, advocates and practitioners in this field begin to use nomenclature which reveals an ambiguity about what their end product will actually entail. In the case of Ontario Genomics, we come across plans to design and engineer "new biological entities" to cure diseases, mitigate climate change and substantiate global sustainability."

The vision is appealing. The results, if achieved, could be beneficial beyond one's imagination. Does the end result, however, raise questions as to whether the human being will be re-defined or augmented in a way that changes the premises of human identity in some, unintended way. Once again, as in the case of AI, the spectre of Unintended Consequence rears its head.

Governments – and specifically the US and UK – have invested more than one billion dollars in this field while private sector interests move fairly aggressively with investments aimed squarely at some of the most intractable problems we face on this earth. Once again, though, let's beware of unintended consequences in a world vulnerable to destructive tendencies and entrenched divisions.

Synthetic biology is already being used to replace petrochemicals in some products, and plants are being developed to replace meat in hamburgers, all good things. However, synthetic biology could also be used to develop pathogens that can threaten human beings.

An editorial in the April 6th, 2019, edition of the Economist Magazine foresees "synthetic biology (having) a cascading effect (on society), transforming human relationships and potentially, the biological nature (of people.)" The publication points to the need for foresight through which to unleash the "promise" and contain the "peril" of synthetic biology.

Promise and peril are the same adjacencies that are frequently used to describe the impact of artificial intelligence and for this report, we see "peril" manifest in large swaths of uncertainty and projected change that can infiltrate one's perceptions of what constitutes being a productive person. Questions of this depth – when placed into the public square – invariably raise uncertainties and apprehensions that can be difficult to resolve and contend with emotionally.

An Answer to Schizophrenia?

The NIH/NIMH website: "we have learned from all this that "genes and physical characteristics of the brain do not operate outside of influence from the environment and …. by influencing the environment we live in, we can have a positive influence on how a brain works and continues to grow."

Against that backdrop, there is a series of other transformative developments that will help change – in historical ways – how science, society and individuals perceive and approach mental health problems. One source of this transition to the future is the biggest-ever genetic study of mental illness as reported in "Scientific American."

Research by the Working Group of the Psychiatric Consortium studied 37,000 people living with schizophrenia and found 128 variants associated with the disease in 108 locations in the human genome and another NIMH-funded study discovered a possible "neural signature - a pattern in the way a brain circuit works - that may help predict the onset of psychosis."

This points to the prospect of identifying people who may benefit from early intervention but also "the findings may also hold clues to the underlying brain mechanisms involved in schizophrenia." Versions of a gene linked to schizophrenia may trigger runaway pruning of the teenage brain's still maturing communications infrastructure.

A team of scientists at the Broad Institute and Harvard Medical School analyzed the genomes of 65,000 people plus postmortem brains "to discover the secrets of schizophrenia's strongest known genetic risk, a gene called C4. Described as the "tallest tower of schizophrenia's genomic skyline," scientists found that C4's role represents the most compelling evidence to date linking specific gene versions to a biological process that could cause the illness."

Their report says, "the human genome is providing a powerful new way … of prying open (this disease), peering inside and starting to see actual biological mechanisms of schizophrenia." Dr. Bruce Cuthbert, former Acting Director of the NIMH, now Head of its influential Research Domain Criteria (RDoC), declared these findings "a crucial turning point in the fight against mental illness.

"And thanks to this genetic breakthrough," he says, "we can finally see the potential for clinical tests, early detection, new treatments and even prevention."

Which, scientists say, could materialize in the form of "future treatments that suppress excessive pruning (of the teenage brain), counteracting runaway C4 and nipping in the bud a process that could otherwise develop into a psychotic illness." In effect, methods of prevention and treatment agents of this nature are already in development.

Dramatic stuff.

Boundaries of Mental Disorders

Prevention of the disabling and deadly effects of mental illness is likely the most promising course for the future. Dr. Christine Ladd-Acosta, Assistant Professor, Johns Hopkins Bloomberg School of Public Health, says the first step is knowing which specific places in one's genome will contribute to risk. "I am trying to see some of the courses of disease and if I can identify them, we could prevent them from happening. We know that in mental health disorders, there is a genetic component, but the environment contributes to risk as well, so it is likely both".

The results of numerous studies have made strong arguments that the boundaries among many disorders are more fluid over the life course than psychiatric guidelines have recognized up to now. It is now known that many symptoms assigned to a single disorder may occur, at varying levels of severity, in many other disorders. The preamble to the Diagnostic Statistics Manual (DSM-V) says "it is anticipated that future clinical and basic research studies will focus on mental illnesses as "dimensions" or spectrums of symptoms rather than the more narrowly-defined and exclusively-labeled "disorders."

The "dimension" approach versus the labeling of specific disorders as purportedly distinct entities are now being explored and indications are that the broad risk of mental illness is suggested by problems in how a person is able to integrate their thoughts, plans and actions within their own fundamental experience in the world. NIMH funded the research and Dr. Cuthbert saw the results demonstrating the potential to diagnose mental disorders "with the same precision of diagnosing so-called physical conditions."

New Research Domain Criteria

The US National Institute of Mental Health has concluded that the current designations of mental disorders for diagnostic purposes do not represent "valid disease entities". In a dramatic move, the NIMH has re-written its rules for funding mental health research, introducing new "Research Domain Criteria" (RDoC) to incorporate genetics, neuroimaging, and cognitive science into future diagnosis based on neural systems.

The new NIMH framework incorporates neurobiology into whatever causes and whatever constitutes mental disorders – that is, what is normal and abnormal in the function of the human brain. Over the past two decades, NIMH and other agencies have funded research to understand mental disorders as brain disorders, increasingly recognizing these conditions as neurodevelopmental disorders starting in fetal or early post-natal life.

But "symptoms may not manifest for years or decades and this means the ideal time for intervention may precede symptom onsets by years," Dr. Cuthbert says. "New diagnostics will likely redefine mental disorders as brain circuit disorders and new treatment will focus on tuning these circuits."

The brain continually re-wires itself and changes gene expression as a function of learning and of life events. The brain is organized around tightly-regulated circuits that serve perception, motivation, cognition, emotion and social behavior. Dr. Helen Mayberg at Emory University School of Medicine, Atlanta, Georgia, says: "Depression is a disorder of brain circuits and this knowledge will one day lead us to treatments targeting the abnormal brain wiring and the failure of communications between regions of the brain through those connections.."

Comparable Risk for Several Disorders

This moves psychiatry away from subjective reports and observable symptoms as the exclusive basis of diagnosing and treating mental disorders. One compelling reason for this change is that the diagnostic guidelines for mental illness – contained in the Diagnostic Statistics Manual (DSM-V) - *"show almost no influence of the remarkable advances in new technologies and substantive knowledge in neuroscience and behavioral science since release of the DSM-IV in 1994."*

Dr. Cuthbert: "Fact is, we can now move forward to support revolutionary findings for a new, biologically-validated approach to diagnosis." Based on this view, one might conclude that a new classification system will be based on this key discovery, that illnesses such as depression, bipolar disorder and schizophrenia will no longer be considered watertight compartments.

The reason being: science has found common genetic variances.

Drs. Insel and Cuthbert: "There is growing recognition that nearly all genetic factors identified thus far seem to confer somewhat comparable risk for schizophrenia and bipolar disorder but perhaps also for unipolar depression, substance abuse and even epilepsy." To illustrate: psychiatry's Consortium Working Group analyzed data from 135,000 people with major depression and found multiple genetic changes working together to increase the odds of developing depression.

Up to now, research had identified only 14 genetic spots associated with specific genes connected to depression. By examining 9 million single gene mutations, the Consortium identified 44 statistically significant genetic spots involved with depression. Some of these genes were associated with weight, body size, neuron development, brain inflammation, regulating overactive "fight or flight" systems, emotion regulation and decision-making, executive functions of the brain, emotion.

Overlapping Genes

The Consortium also found that depression's genes overlapped with 6 genes linked to schizophrenia. In the largest genetic study of mental illness up to 2013, researchers found that five major disorders share gene-based variants and yet manifest in different ways. These are autism, ADHD, bipolar disorders, major depression and schizophrenia.

Meanwhile, researchers at the University of Denmark found that "psychiatric illnesses are connected." They say, "the concept of shared inheritable risk underlying mental illnesses could lead to a paradigm shift in drug discovery targeting root causes." Dr. Anne Bassett is head of Clinical Genetics at the prestigious Centre for Addiction and Mental Health in Toronto, says: "we are all born with genetic risks or vulnerabilities and fully one half of all our genes relate to our brain and nervous systems and are the most important part of causation of serious mental disorders".

Dr. Rémi Quirion, Chief Scientist of Quebec, concludes that the combination of "genetic predisposition" and social environment ("gene-environment") including stress, trauma, lifestyle and nutrition likely determine one's risk to depression, anxiety and other conditions.

Prevention Starts in Childhood

These developments may well establish the basis of preventing mental disorders from the pre-natal period through childhood. Dr. Marisa Young, **BILL TO INSERT TITLE** logically, the concept of prevention embracing the family experience in the development and onset of mental illness.

This broader context provides greater clarity for the identification of "those points of intervention" that can reduce, even prevent the effects of mental distress and disorders. Signs point to mental illness as a "neurodevelopmental disorder with changes occurring in fetal or early post-natal life" but "with symptoms that may not manifest for years or decades."

Dr. Cuthbert thus concludes: "This means the ideal time for intervention may precede symptom onset by years." In this context, he says, "one of the most powerful and precise interventions to alter brain circuit activity to relieve patients (with mental illness) may be targeted psychotherapy."

He says the goal of the new NIMH Research Domain Criteria (RDoC) is to "understand mental disorders as deviations from the normal functioning of brain systems rather than continue with inadequate symptom-based definitions. The new research criteria is moving through research to a new system of the classification of mental disorders."

All these issues demand unprecedented collaboration across many scientific disciplines from neuroscience, medicine, genetics, epigenetics and mathematics, social sciences, economics, physiology and cognitive sciences.

"European Roadmap" Follows Similar Route

For similar purposes as the RDoC initiative, the European Commission funded a Roadmap for Mental Health Research and the European Union Innovative Medicines Initiative advocates linking psychiatry with neurobiology. Called ROAMER, this initiative has led to new efforts in Europe to transform diagnosis.

Further, an accelerating body of literature over the past decade calls for a "new clinical system for mental illness based on biology as well as (clinical observations.) But can change happen? Is inertia pending? Valid concerns. The existing system is "embedded in the machinery of regulatory agencies, granting agencies and journal reviews …. making it difficult for research to divert from current conventional thinking."

Nonetheless, the NIMH Research Domain Criteria opens the door to "new thinking" about what mental illness is, and what it isn't. Recapping these points for emphasis:

- Serious mental disorders increasingly appear to be neurodevelopmental which means symptoms develop early and progress over time;
- Mental disorders are brain circuit disorders resulting from a wide variety of problems in the maturing of the human nervous system from conception.
- The social and physical environment in which people grow up, live and work can – through life -- constitute both risks to mental health and a protector of it.

Leaders in Canadian Clinical Innovation

The transformative approach to re-defining and thus more effectively managing mental illness has been embraced by leading Canadian scientists at the Centre for Addiction and Mental Health in Toronto. There, Dr. John Haltigan

is "searching for why some of the most hard-to-treat or pervasive mental illnesses – from autism spectrum disorder to depression - occur among children and young people."

His work is described as "being part of a larger movement to break apart existing definitions of mental illnesses into their underlying components – into the symptoms, behaviors and biological factors associated with mental illnesses." Thus, reflecting further movement away from current labels. "The standard approach" Dr. Haltigan says, "defines mental illnesses as though they are discrete entities but many – if not most – occur in multiple disorders.

"In a single categorically-defined mental illness, there can be a wide variation of symptoms," he says. The Centre for Addiction and Mental Health is Canada's largest mental heath teaching hospital and, there, Dr. James Kennedy is carrying out research dedicated to finding genes involved in the cause of mental illness.

A report, "CAMH IMPACT", says the "current trial and error method for prescribing medications often results in non-response and/or side effects. Only half of patients respond to initial treatment with prescription medication. "Dr. James Kennedy and his group from the Centre have found that pharmacogenetic testing of liver enzymes is clinically useful in prescribing medication. Personalized prescribing ensures patients receive maximum benefit."

PART FOUR

The Biology of the Human Mind

The Brain and Behavior: Is that all there is?

There is quite naturally some discomfort among people to think about their thoughts, feelings, perspectives, fears and apprehensions as biological functions performed by the human brain. Where is the human spirit in all this? Where is personal accountability? Where is religious faith? Where is belief in something greater than oneself? Are all of these things just biology?

The author makes no claim to know the answer to that question. But it is interesting to note that one of Canada's greatest neuroscientists, Dr. Philip Seeman, once told the author that when he was with patients who died, he noticed that the "glisten in their eye" was the last to leave. He wondered aloud, could that be the departure of the soul? If a world-renowned scientist can ask such a question, so can we all.

But not, arguably, at the expense of what we know to be fact. And knowledge of the human brain – while profoundly incomplete, as we noted earlier - is progressing thanks in a big way to the designation of the 1990s by the late US President George H, W. Bush as the "Decade of the Brain."

Science learned more in that ten-year span as to how the brain works than in the previous years of recorded human history. But mysteries continue as to the conscious state of human beings amid the impenetrable complexity of the brain. It is conceivable we will never know some of the fundamental truths of what it means to be human as devised, dictated or demonstrated by the human brain.

Afraid of the Truth

Are we human beings afraid of the truths we will find if we probe and learn ultimately what our brain does and how – and, importantly, why? Are we more interested in exploring the outer space of the cosmos than the inner space of our being? One man, in fact, wanted to do both.

The Late President John F. Kennedy not only launched the American space industry, he was the first US president to sign a law aimed at ridding his country of discrimination against those living with mental illness.

His nephew, former US Congressman Patrick Kennedy has used the analogy of the "inner and outer cosmos" to make the case for greater investments in sciences of the mind and to the author, those sciences must include not only neuroscience, per se, but genetics, epigenetics and, importantly, the social sciences through which human behavior can better understood.

Combined with medicine, psychology, business and economics, we might find an integrated model of inquiry that will get us closer to understanding why human beings treat each other so cruelly on such a large scale and why violent behavior mostly - in overwhelming numbers - is not due to mental illness but is assumed to be.

The new Attorney-General of the United States said his first (and probably only) priority in dealing with gun violence in that country is to solve the access to guns of those who are "mentally ill." Or, as he put it predictably vaguely, the "mental health problem in this country".

As the late, great US Senator, Patrick Moynihan, put it: "we are all entitled to our own opinion, but not to our own facts." And the facts in colloquial terms are these: most – by far – of the crazy things that are done in this world are done by legally sane people, by people who are calculating and angry, not crazy.

Mental illness is rarely involved in violence, and when it is, it is likely, by way of psychosis, a mind-state produced not by mental illness only, but also by drugs, alcohol and isolation. One form of mental illness where psychotic "breaks" can happen, schizophrenia, afflicts less than one to two per cent of the population overall. In most cases of mass violence of the nature we see too often, the trigger is deeply-seeded anger, alienation and isolation, not mental illness.

Moving From the Mysterious

The legendary Dr. Eric Kandel writes that science is moving from a decade concerned with probing the mysteries of brain function to a decade of exploring treatment for "brain dysfunction".

"What we are learning about autism, schizophrenia, depression and Alzheimer's Disease can help us understand the neural circuits involved in social interactions, in thoughts, feelings, behavior, memory and creativity just as surely as studies of these neural circuits can help us understand brain disorders. In a larger sense, much as the components of a computer reveal their true functions when they break down, so the functions of the brain's neural circuits become dramatically clear when they falter or fail to form.

"The processes of the brain that give rise to our mind can become disordered, resulting in devastating diseases that haunt humankind (autism, schizophrenia, depression, Alzheimer's Disease, Parkinson's Disease and Post traumatic Stress.)"

Implications of Dr. Kandel's Insights

How the practice of medicine will likely change in at least two ways:

> **One**, neurobiology/neuroscience and psychiatry will merge into a single clinical discipline focusing on the patient as an individual and taking us closer to "personalized medicine" in treating mental illness.

Two, bringing a greater understanding of the biological processes of mental illness into the clinical diagnosis and treatment of these conditions.

According to Dr. Kandel, in the not-too-distant future, children at high risk for schizophrenia, depression or multiple sclerosis will be identified and treated to prevent these conditions from developing later in life. "Similarly, middle-aged, older people may benefit from a determination of their individual risk for late-onset Alzheimer's or Parkinson's Diseases.

The biology of mental illness is not confined to the brain. It migrates into the body. Clinical evidence points to a free trade of complications between brain and body – between mental illness – especially depression – and disorders such as cardiovascular disease and diabetes. This establishes a brain-body continuum governing mental health problems and treatment outcomes among other chronic, concurrent disorders.

Mental Health International developed a MATRIX to display the connections between depression and these various conditions and, therefore, the brain-to-body effects of this common mental disorde**a Country**

New data demonstrates that mental disorders are compromising gains in life expectancy that the world has achieved over the past 50 years. Indeed, Americans living with major mental illness in several US states have seen their lifespan fall below that of Sub-Saharan African countries with emerging economies such as the Sudan (58 years) and Ethiopia (52 years).

Let us examine the details behind the Matrix. For one thing, mental illness is heavily concentrated among men and women in their prime years of work - plus their adolescent children. Thus, the well-documented heavy economic cost burden imposed by these conditions.

If mental illness was a country, it would be among the world's ten most populous. Notably, as the insurgency of mental illness across the globe took hold over the past 20 years, other public health trends also emerged. From a landmark article for Foreign Affairs magazine by Dr. Thomas Insel, former Director of the National Institute for Mental Health, and Dr. Steven Hyman, Director, Stanley Centre for Psychiatric Research at the Broad Institute of MIT and Harvard:

- Infectious disease has given way to chronic non-communicable disorders as the principal public health concern of the times and as a result, non-communicable (or chronic) disorders, such as heart disease and diabetes and depression, now pose a greater public health risk than contagious or infectious diseases.

- The Harvard School of Public Health's (updated in 2010) Global Burden of Disease Report revealed that non-communicable diseases caused 63 per cent of all deaths around the world, mostly in low- or middle-income countries.

- The Global Burden of Disease report said that between 2010 and 2030, chronic, non-communicable diseases will reduce global GDP by $46.7 trillion (US)

- The biggest source of those future costs are mental disorders, representing, by 2030, one-third of the global economic burden of all non-communicable disorders - $6 trillion (US). More than heart disease, cancer, diabetes and lung diseases combined.

According to the London School of Economics nearly a third of all people with long-term physical conditions have co-morbid mental health problems like depression and anxiety and mental disorders are clearly the "most important" health challenge among working men and women.

A Chain of Complexity

Following is a brief review of the co-morbidity between mental illness and other chronic disorders as captured by various scientific reports, summaries and studies beginning with a report by Harvard University researchers: *"Depression is both biological and social in origin. Causal pathways that transform social experiences into (mental illness) are unknown.*

"Current research provides strong evidence that all mental disorders are biosocial and that whatever psychological processes are involved, the quality of a person's social environment influences both vulnerability to, and the course of mental illness.

"Mental illness is not simply symptoms of broader social conditions, nevertheless, poverty, lack of security, violence, lack of healthy family relationships during childhood and the trauma of significant loss are crucial factors for mental illness.

"Mental illness is most often found in constellations that bind together biological forces, social conditions, cultures and (other) particular forms of illness. (That said), the correlation of job loss and recession and increased rates of suicide and hospital admissions for mental illness demonstrate a link between the two."

Other findings and statements concerning the cross-over between mental illness and other health conditions:

- *Depression and coronary artery disease have a bi-directional relationship and depression may contribute to sudden cardiac death. (Montreal Heart Institute, Ottawa Heart Institute, Mayo Clinic, others.)*
- *Depression and bipolar disorder increase the risk of coronary artery disease which ultimately causes heart attacks. (Dr. Benjamin Goldstein, Sunnybrook Health Sciences Centre.)*
- *As a result, the world's top killer, heart disease, and its greatest disabler, depression, now constitute a powerful one-two punch to productive capacity in the workplace. (Global Business and Economic Roundtable on Mental Health.)*

(Dr. Salim Yusuf, one of the world's great leaders in cardiology at McMaster University, hopes to do the largest ever - 200,000 subjects - study of the co-morbidity of depression and heart disease to determine if these conditions are, in fact, bi-directional or does one lead to the other.)

Diabetes raises the risk of dying from cancer and 80% of those living with diabetes die from cardiovascular disease and depression is linked to both. (New England Journal of Medicine, Canadian Diabetes Association) and depression is associated with faster tumor progression and shortened survival time among cancer patients. (Supportive Oncology Magazine).

The Kings College Institute of Psychiatry in London, reports that people with serious mental illness have lower cancer survival rates than the general population." Several forms of mental illness occur with multiple sclerosis, the most burdensome are depression and anxiety. ("Neuro Transmission (magazine) – Essential Management of MS."). And greater levels of a brain protein (monoamine oxibase) may explain why postpartum blues and clinical depression are so common after childbirth.

Further:

- People with depression may have triple the risk of developing Parkinson's Disease and depression occurs in 45% of those living with PD. (American Academy of Neurology and the Journal of Neurology.)

- The worse pain gets, the greater the risk of depression (Cleveland Clinic) and people with psoriasis who are diagnosed with depression are 37% more likely to develop psoriatic arthritis. (Journal of Investigative Dermatology.)

One of the most striking findings in the area of co-occurring depression and cardiovascular disease is the singular impact of youth. A 2015 study for the American Heart Association – with Canada's Dr. Roger McIntyre on the study team – found that depression and bipolar disorder constitute a "moderate risk of cardiovascular illness among young people.

Further, in a major epidemiologic study, 50% of adults with mental illness described onset by age 14; 75% by age 24, explaining much of the tragedy of teen and young adult suicide. Turning to this tragic subject.

US Suicides "Skyrocket"

In Europe and the US, suicides spiked in the wake of the 2008 financial crisis, reversing an opposite trend that had set-in before then. Every year 45,000 Americans kill themselves.

In many, if not most, suicides, a heart breaks before a life ends. Case in point: "*Jake" (not his real name) was called into his boss' office. He was fired, was "walked out" in front of all his co-workers, humiliated. He went home and hanged himself.*

When it comes to suicide, men die the most, women try the most. Suicide is the leading cause of violent death in the world today and, in the US, guns claim more lives through suicide than murder.

The increased risks of suicide in the wake of the 2008 financial crisis prompted the Bank of England to declare war on the stigma of mental illness in support of employees who experienced major stress and worse post 2008.

World Health Organization data shows that following the great recession of 2008, nearly all societies in Europe experienced rising suicide rates. These can be looked upon as the fatalities of a man-made financial crisis.

Similar trends were recorded in North America where suicides increased 4.5% in that same post-crisis era. Bloomberg News reported: "the world of high finance has historically been prone to a spike in suicides during and after intense crises."

"The concern now is that the aggressive and punishing culture of the financial services industry may be inflicting more permanent damage and suicide rates are a harbinger of this trend."

Epic Loneliness

At a time when social media has become a weapon of mass distraction – ironic since connectedness is now big business – isolation and loneliness are sadly a sign of the times. Frequently at the expense of human life. An oft-cited 2015 meta-analysis from researcher at Brigham Young University showed loneliness and social isolation are as deadly as obesity and smoking and a lack of physical activity.

Why is loneliness so toxic, one writer asks? One reason, scientists are finding, is that it is form of stress known to have a wide range of health consequences including high blood pressure, poor diet, no sleep. A wealth of research shows that "a sense of being cared for and loved is crucial to our well-being" – as vital as air to breathe, oxygen, equality, thriving relationships. "

Dr. Parminder Raina, Head of the Institute of Aging at McMaster University, says "social isolation is all about" vulnerability to mental health problems. is linked to all aspects of mental illness. He says the "prevention of risk" is key to healthy aging – specifically, the prevention of "cognitive changes early in life."

Malignant Sadness

As cancer is a malignant growth, so depression is a malignant sadness, to borrow the title of a forthcoming book on the subject by Lewis Wolpen, a British biologist who has had the disease. Modern bio-medicine has tracked both cancer and depression back towards their molecular roots, but, as yet, the world's burden of suffering in both cases has eased only a little.

Fifteen per cent of severely depressed patients kill themselves; two-thirds contemplate suicide and "Steps Toward Suicide", based on an analysis by Mental Health International, are these

Ten Steps Toward Suicide:

1	Emotional isolation	7	Desperation when resolve peaks
2.	Malignant loss of self-esteem and usefulness	8.	Family history of suicide
3.	Loss of motivation to live	9.	Among youth and children, altered perceptions of death and dying
4.	Void of joblessness		
5.	Impulse	10.	Social disadvantage and grievances
6.	Drugs and alcohol		

The chain reaction inherent in these ten steps can be broken. Among the most important tools we have in doing so are friendship, love and actual human connection (not via a hand-held device). The World Health Organization has estimated that globally:

More than 1.6 million people died in violent circumstances in the year 2000 and, of that total, 815,000 died by suicide, 520,000 were murdered and 310,000 died in armed conflicts including terrorist attacks.

- Expressed another way, "one person in the world commits suicide every 40 seconds, every minute, there is a murder and someone dies as a result of armed conflict every 100 seconds."

"Killing ourselves faster than each other"

Which means that as many people died by their own hand than were killed by someone else. The WHOs Etienne Krug summed it up this way: "We are killing ourselves at a much greater rate than we are killing each other."

In late 2018, the Economist Magazine reports that suicides in the US skyrocketed by 18% while globally, suicide has declined by 29%, saving nearly three million lives.

The suicide crisis in the US is rooted among "white, poorly-educated men in areas that were left behind by booms and crushed by bust." The New York Times' esteemed columnist, David Brooks, reported on latest data showing that suicide rates all over the world have risen by over 30% this century, that teenage suicides are twice that.

PART FIVE

Interpretations and Conclusions

This report is not definitive. The author is not an expert in artificial intelligence and genomics, and, for purposes of this project, should be seen as a reporter and writer who studied these topics while bringing to the task some 20 years of (near) full-time advocacy in the mental heath field, especially as it pertains to working populations and their families.

As to what might we conclude from this Report, the author offers the following while others may find other conclusions and interpretations.

Let us begin with Artificial intelligence – and specifically the scale and scope of uncertainty and insecurity that it will bring to the workplace and job market, as well as its effects on employment and the self-identity of people in all walks of life and in all kinds of jobs.

It is notable that the risks of AI as set out in this paper have been cited by proponents not opponents of artificial intelligence. On this basis, one can conclude that AI represents a clear and present danger to the brain-based mental health of working populations and their families.

At the same time, certain technologies and applications of artificial intelligence are now being developed that will help individuals, families and clinicians to better manage emotional distress, brain-based symptoms and the discerning physical effects of mental illness. Thus, the Great "Promise and Peril" Dichotomy is at hand.

Further, as epigenetics delvers further into the molecular basis of mental illness to pin down the mechanisms of development and onset, AI will be a powerful tool for analyzing the immense number of data points that will accumulate through epigenetic investigation.

On a larger scale, research is already underway to dig deeper into the mysteries and maladies of the human brain as it reveals itself and its dysfunction through mental illness. Using AI and other technologies, science will ultimately discover ways in which to map the human brain, the dynamics of mental illness and will one day get us closer to the means to prevent mental illness by reducing risk even well before symptoms appear

What is needed then - in the light of this "promise and peril" - is a comprehensive international, well-coordinated public inquiry into the penultimate risks and opportunities that artificial intelligence presents in terms of increasing or decreasing the mental health burden expanding across the world. There are many vehicles already travelling the AI circuit that could absorb such an inquiry including the tremendous work being done internationally and nationally by the Canadian Institute for Advanced Research and its allied units.

In some respects, CIFAR has already embarked on inquiries of this nature. This report contains an informative basis for incorporating brain-based mental health into all this work. After all, the brain houses human intelligence and without that, the model for AI doesn't apply.

Needed are standards, policies and practices that are prominently posted in every workplace, in every market place and at every turn that the human being, not the machine, is, with our natural environment, the "precious cargo" of life on this planet.

We need not look far for guidance in this respect. Canada's Charter of Rights and Freedoms says Canadians are free to have their own thoughts, do their own thing and be unto themselves as they determine and decide, subject to the same rights and freedoms of others. Other nations, of course, have their own constitutions. The point is this: surely we have reached a time and place where the idea that smart machines would be welcomed vessels of intrusion upon these precepts is both outlandish and unacceptable.

Let us also understand this: if "social media" is the model for the infusion of artificial intelligence in the terms now under discussion then there will pain aplenty as evidenced by the way in which hand-held devices are changing social norms as weapons of mass distraction and sources of addictive consumption. Could we disengage even if we wanted to?

Let us also be clear: some of the most invasive and dangerous forms of stress are deeply-seated apprehension and fear, frustration, rumination or seething which predicts depression, alienation and anger, dislocation and despair. The loss of livelihood and the loss of self are consequences of one's own fading identity and place in our communities and our places of work. This is part of the perilous potential of artificial intelligence.

Turning to Genetics and Epigenetics – three things:

1. Genetics has given us the first basic, molecular clues of the causes of mental illness and the newer science of epigenetics – the bridge between our genes and our environments – is providing a strong scientific basis for our understanding that the environment dominates the risk of disease including mental illness. In turn, stress is the "overwhelming even dominant" cause of mental illness.

   Meanwhile:

   - A genetic breakthrough in scientific understanding of schizophrenia is opening the way for new clinical tests, early detection, improved treatments and even prevention.

   - Genetics has given science new information on genetic variants shared by differently "labeled" disorders demonstrating that these (depression, bipolar, schizophrenia, others) are not watertight compartments. This information will lead to a new system classifying mental disorders and a better-illuminated path toward treatments and interventions that work.

2. Epigenetics stands out as a hopeful – so very hopeful – instrument of discovery to rip away the facades of social and economic environments that impair human health by generating hostile, chronic stress. One day, epigenetics may well help answer how and why stress inflicts such damage. Even as a distant star, this proposition presents some tough truths.

   - The kind of atmosphere and environments we create for everyday life and work, the way we treat each other, relationships at work or at home, the oppression we place on others, the confusion we spread and the anxiety that that breeds, the fear we engender, the political rhetoric we deploy, the bullying

we inflict, the trauma we impose upon children, the cigarette we smoke or the drink we take while pregnant and –

- The abuse and intimidation we hurl at each other through social media, the diet we live by and could die from, the hurry and the worry about the job, about globalization, the "pain drug" epidemic, struggle to juggle duties and commitments: these are all human traits and behaviors that are born of and feed into the stress epidemic that attacks the human mind, body and spirit.

3. Despite all this, scientifically and societally, we chronically "under-invest" in "stress". Why is that? Are we so familiar with the whole "business" of stress that we presume we already know enough about it, or that stress is the unavoidable price of admission to and badge of honor for a busy, successful life. We may know the particular "stressors" we contend with, but we do not know the state of stress as we need to for purposes of advancing our knowledge of the epigenetic basis of mental illness?

Concluding Observations

Mental illness has biological roots and is a chronic disease with both physical and psychological effects. The distinction between "mental and physical" health problems is mute and inaccurate. The mental and physical are one. The brain and the body are one. The gene + environment connection is very likely how mental illness happens and this fact dissolves the stigmatic absurdity that mental illness is the fault of the person suffering it.

Artificial intelligence may well be the harbinger of a global skills crisis and unless resolved through employee re-training and skills re-development. That said, the apprehension and the reality of AI-based job displacement and job security may be two different things. The fact is the former can do damage and the latter will.

The nomenclature of artificial intelligence must be calibrated so as not to imply or communicate any ambiguity among AI designers and users as to the clear distinction between the superiority of human beings and functional purposes of artificial intelligence.

Terms such as "sentient beings" and "biological brainpower" are self-revelatory as to the inference they draw. That is, terms of this nature replace the simple clarity of "people and persons" and imply that the distinction between people and machines, for these purposes, is unclear. Ambiguities of this nature are chilling.

Arguably, the phrase "artificial intelligence" should be dispensed with, as it sets up a false equivalency between machines and people through the inevitable "partner phrases" artificial intelligence and human intelligence.

The nomenclature of mental illness is likely to change as a new classification system emerges on the strength of scientific and clinical recognition of these conditions as a spectrum not highly-distinct, water-tight compartments and labeled as such.

At the same time, the term mental illness, per se, is heavily and probably hopelessly stigmatized. A look at the synonyms for mental illness ('crazy, lunatic') that are listed in on-line dictionaries demonstrates how entrenched the stigmatization of mental illness is in our culture. A topic for another day.

Recommendations:

Mental Health Included AI Pan-Canadian Strategy and Quebec AI/Societal Initiative

All of this brings us back to Dr. Bernstein's statement that the revolutions in genomics and artificial intelligence may put to the test our cherished assumptions about what it means to be human. Perhaps the most fundamental nature of our humanity is our power to perceive, to discern, to love, to apprehend as we look ahead, to think creatively and compassionately and empathetically.

On this basis, it is the recommendation of the author of this report that mental health considerations across the spectrum of issues discussed in this document be incorporated into Canada's National Strategy for "Artificial Intelligence" and Quebec's Observatory on the Societal Effects of AI.

Canadian Royal Commission on Human Development and Dignity

Canada's system of government is based on the British model of parliamentary democracy and has employed a form of national inquiry into issues of fundamental consequence such as bilingualism, free trade and the law. This procedure is called a Royal Commission and in the face of the revolutions in genomics and artificial intelligence, an argument could (and should) be made for a **Royal Commission on The Prospects for Human Development and Dignity in the 21st Century.** Thus, Canada becomes a proxy for the world.

Society and Science Coming Together

In some form, it is recommended here that science and civil society including employers and unions come together in a workable form to create a **Roadmap to Prevention of the Deadly and Disabling Effects of Mental Illnesses** including steps forward, timeframe and necessary investment targets to support such a bold initiative. This would, by necessity, engage AI technologies.

Workplace Standards and Protocols

Special measures are called for to equip workplaces with tools to establish fair, just, reasoned, prudent and empathetic values that will guide the implementation of artificial intelligence given the highly-sensitive, potentially disruptive and stress-ridden nature of artificial intelligence if introduced careless, callously and not transparently. A specific tool is proposed in Summary Part Five combining the enunciation of values, quantification of threats and steps to mitigate those threats against those values.

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(Attachment of author bio follows)

BILL WILKERSON,

Executive Chairman, Mental Health International. February 2019

'An Enduring Partnership with the Honourable Michael Wilson'

Bill has been working on mental health issues since 1998 with the late Michael Wilson, Canada's former Minister of Finance and Ambassador to the United States. Michael and Bill developed and published the first-ever 'Business Plan to Defeat Depression' in 2000 in association with the Dean of Health Sciences at McMaster University. It attracted national attention in Canada and news coverage in the US and Europe having been released in Toronto and Geneva at the World Health Organization. The two men also calculated the economic impact of mental illness in Canada, a first at that time.

Michael and Bill led the Canadian-based Global Business and Economic Roundtable on Mental Health and launched the US/Canada Forum on Mental Health and Productivity in Washington when Michael was Canada's Ambassador to the US. The Forum then alternated between US and Canadian cities – Ottawa, Boston (at Harvard University), Toronto twice and Denver. Michael and Bill then convened a series of CEO Summits between 2002 and 2013 that put 'mental health in the workplace' solidly on the corporate map.

In 2013, Bill – with Michael's support - turned his attention to Europe, chairing a 4-year business-led campaign called TARGET DEPRESSION IN THE WORKPLACE and the European Business Leadership Forum for Mental Health in the Workplace. For this campaign, Canada's Ambassadors to Denmark, United Kingdom, Spain, Italy, and Belgium hosted roundtable meetings with European business leaders for Bill who travelled to more than 20 European capitals to promote the campaign, taking his message to institutions as diverse as the European Central Bank and Royal Mail and overall, to employers with one million employees in Europe. Bill ended the campaign in 2017.

ON NOVEMBER 20, 2015, McMaster University, among the top 75 universities in the world, conferred upon Bill an Honorary Doctor of Laws, its highest recognition, for his work in mental health across international borders, and appointed Bill to a 3-year term as Industry Professor of International Mental Health.

Throughout the 20 years Bill Wilkerson and Michael Wilson worked together to advance mental health and fight mental illness, both were recognized widely for their work including the Public Service of Canada. Bill was also sworn-in as the RCMP's first civilian mental health adviser. Before his mental health advocacy, Bill Wilkerson served in a wide range of chief and senior executive roles in business, broadcasting and the arts and was a crisis management and news media consultant to major corporations and major league sports including the National Hockey League.

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APPENDIX I

ROI of Mental Health in the Economy

One of the most powerful incentives to invest in the mental health of working populations is, of course, protecting their asset value as well as reducing the costs of mental illness which, ironically, weigh most heavily on business and the economy and not 'health care' or allied fields of expenditure. Three major Euro-based studies have been done over the past three years which demonstrate that investments in mental health produce a measurable return through improved rates of industrial productivity.

Let us examine these studies briefly.

1. World Health Organization: Analysis of 36 Countries (2015)

An analysis by the World Health Organization - funded by Grand Challenges Canada – cites "depression and anxiety as highly-prevalent and disabling disorders which (produce) not only an enormous amount of human misery and lost health, but also lost economic output." Projecting health outcomes in 36 countries between 2016 and 2030, factoring in increased treatment, modest gains of 5% in improved ability to work and new productivity resulting from treatment, the WHO found that:

- *"The net present value of investment needed over the period 2016-30 to substantially scale-up effective treatment coverage for depression and anxiety is US$147 billion.*
- *"The expected returns on this investment are substantial. Scaled-up treatment leads to 43 million extra years of healthy life over the (next 35 years)."*
- *An economic value on these healthy years of life produces a net present value of US$310 billion. On top of this, scaled-up treatment of depression and anxiety leads to large productivity gains of US$399 billion.*
- *Therefore, the benefit-to-cost ratio is 2.3/3.0 to 1 when economic benefits alone are taken into account and 3.3/5.7 to 1 when the value of improved human health is included.*

The WHO concludes this: across the 36 largest countries in the world, in the absence of scaled-up treatment, more than 50 million days of work will be lost to depression and anxiety every year. The WHO found that:

- Worldwide, investments in mental health are meager with most low- and middle-income countries spending less than US$2 per year person compared to an average of more than US$50 in high income countries.
- There is a 'treatment gap' that affects not only human wellbeing "but has inevitable consequences for employers and governments as a result of diminished productivity at work, reduced rates of labor participation, foregone tax receipts and other health and welfare expenditures."
- "Several national and international studies have shown the enormous economic challenge these disorders pose to communities and society through foregone production and consumption opportunities."
- In 2010 numbers demonstrating that lost output due to mental, neurological and substance abuse disorders illness cost US$2.5 -8.5 trillion worldwide.

For all 36 countries in the WHO study, total costs are US$91 Billion for depression and $US56 billion for anxiety. There are three distinct benefits of improved treatment of these conditions - improved health effects; improved economic effects; improved social effects (individuals/households participating in society.)

2. ***European Commission Agencies: Cost Burden Mostly Economic (2014)***

A report for European Commission agencies has found that 84% of the costs of depression in Europe are borne by employers and the economy. Only 16% of these costs are borne by health care and welfare services. "Under current treatment and care arrangements," the report says, "the productivity costs of depression will continue to grow at a significant pace."

The report says:

- When the number of people who leave work due to mental disorders (mainly depression, statistics show) is combined with an aging population, "the number of people available to work in many EU countries is shrinking."
- European employers must prioritize mental health in the workplace to keep employees healthy and productive, and reduce "medically-related early retirements" simply to maintain "the supply of healthy labor."

The imbalance of cost impacts between 'employers and the economy' and the health care system reflects the oft-cited "treatment gap." This, while depression's shadow widens across the working populations of Europe, North America and beyond. This EC Report paints yet another stunning cost picture:

In 27 European countries, the cost of depression alone is €617 billion per annum, broken out like this: the cost to employers is €272 billion/year, relating to the impact of depression on absenteeism and presenteeism while the cost to the economy is €242 billion/year, relating to loss of employment and lost economic output;

Yet, the cost of health care is estimated at €63 billion and disability benefits claimed by people off work due to mental illness is €39 billion.

3. ***KPMG – Mental Health Care in Chaos (2016)***

Citing "Misalignments in Global Mental Health,' the KPMG analysis pointed to a number of the factors behind the bent, largely unpaved road that is mental health care: lack of resources given the disease burden involved; cultures of denial, inevitability and misdiagnosis driven by stigma; no continuum or integration of care; and cost-ineffective use of those limited resources that are available.

"Mental health is one of the largest and most overlooked global challenges accounting for 13% of the global burden of disease and $2.5 trillion in economic loss annually while receiving less than 2% of national budgets.

The KPMG analysis was carried out through interviews and found many of those interviewed saying that "what is really needed is a people-led revolution to influence policy decisions and other sector priorities around mental health." In effect, a 'critical mass' of public opinion and lobbying coming forward to push mental health onto "global priority agendas." That said, KPMG found that more money alone will not sot solve the dilemma.

"Of the 2% in global health spending that is invested in mental health, resources are often allocated in a non-cost efficient manner," with "70% of mental health spending still aimed at long-stay institutions. An obsolete, often cruel concept of care. KPMG concludes that "relative to other disease areas, scientific and technological progress in mental health has lagged" and recommends a number of measures to correct the misalignment of mental health resources including emphasis on community-based programs to break down barriers, greater role for the private sector role and investments for humanitarian crises.

So far, he adds, efforts to discover the pathogenic mechanisms (origin and development) "have been frustrated by complexity of the human brain, limitation in non-invasive technologies, and the difficulty of disentangling causal factors from effects of the disease". NIMH researchers have found 'dynamic' links among motor activity, sleep, energy and mood that could suggest a new focus for the treatment of depression. These findings were uncovered using "mobile monitoring" of individuals.

"Motor activity may play a central role in mood regulation and thus might be a target for intervention – one that can be more easily changed than mood states. Thus, novel pharmacological, physical and behavioral approaches focused on increasing activity and energy may be more effective than current treatments that focus primarily on elevating and stabilizing mood."

Genetic discoveries represent the first absolutely objective clues as to what mental illnesses are at a basic cellular level. Science is moving toward discovery of biomarkers for mental illness, a breakthrough when it occurs. And we seem to be getting closer.

The world's largest mental health research grant-giving agency, US National Institute of Mental Health has introduced new criteria to steer researchers away from the current labels of mental illness, rejecting these classifications as not valid disease entities. The experience of mental illness is real. The way we label them is going to change.

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