Care4everyBody

MIND THE GAP

Costs, consequences and correction of sex and gender inequality in medicine

The Mind the Gap study was commissioned by Care4everyBody, an NGO advocating for gender-sensitive healthcare in the EU. It calculates the economic cost of poorer healthcare quality for women in real terms and demonstrates that appropriate, effective medical treatment of women could save billions of euros lost annually in the EU through medical issues and the loss of economic productivity they cause.

Executive Summary

Women's healthcare is failing women – this has a cost to the whole of society. Based on existing literature, this study calculates this cost by looking at sex and gender discrimination and inequality in medical processes, protocols, and practices. It identifies the causes and consequences, quantifies the costs, and illustrates better approaches and outcomes across medicine.

In 2019, the total annual EU direct and indirect medical costs were **over € 4.76 trillion**. This represents the 9.9% of EU GDP that is spent on health, plus 2.4 times that **from lost earnings and reduced productivity**. The total cost is close to 30% of the annual EU GDP. A large part of this loss can be attributed to the poorer quality of healthcare received by women.

The study provides concrete yet shocking calculations of the economic cost of poorer healthcare for women. It illustrates the discrimination faced by women working in the medical field – from the pervasive use of male examples in medical textbooks to the gender pay gap – and examines the medical conditions that hit women hardest. The report not only identifies the problems but also examines the consequences and the **social and economic costs of inequality.** The calculations are astonishing. It also provides **policymakers with viable corrective policies and concrete actions**

The circumstantial factors that lead to economic loss

Most urgently, the study finds a need to look at **data science discrimination**. The advent of data technologies such as artificial intelligence, machine learning and algorithms, risks **codifying existing sex and gender bias** into emerging products, services, and processes that will be core to medical care in the future.

DATA TECHNOLOGY IS PROLIFERATING IN THE MEDICAL SPHERE: THIS RISKS CODIFYING EXISTING SEX AND GENDER BIAS INTO EMERGING PRODUCTS AND TECHNOLOGY

The impact of closing the gender pay gap would increase the EU GDP per capita by between 6.1% - 9.6%, which amounts to **€1.95 - €3.15 trillion by 2050**. It would add **10.5 million jobs. And** in biomedical research, the **lack of evidence from female patients** may result in delays or incorrect diagnoses, and the application of inappropriate, ineffective, or harmful treatments.

IN FRANCE, 200 WOMEN DIE EVERY DAY FROM CARDIOVASCULAR DISEASES. BUT 8 OUT OF 10 STROKE DEATHS COULD HAVE BEEN AVOIDED WITH PROPER SCREENING.

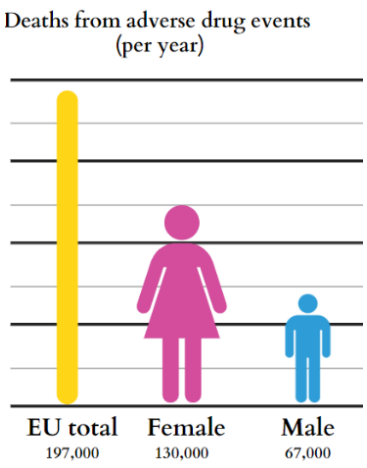
THE IMPACT OF CLOSING THE GENDER PAY GAP WOULD INCREASE THE EU GDP PER CAPITA BY 6.1 - 9.6% AND WOULD ADD 10.5 MILLION JOBS BY 2050.

Issues in Treatment

When standing in front of a mirror few of us see a white, young straight male, of average height, and low BMI. This is **the Adonis model**, which underpins and influences much of modern medicine and introduces biases on many levels of medicine. It proves discriminatory, systemically suboptimal, costly, and too often severely detrimental to women. Although a lot of knowledge on gender differences has been added to the medical literature over the past years, this has yet to reach physicians and patients.

The report identifies three phases of life for a woman (pre-puberty, fertile years, and pre/post-menopause), and walks through the distinct medical requirements of each, finding that **treatments and interventions often fail female patients** – sometimes with **fatal results**.

Drug trial participation has a large sex and gender gap. Most drugs currently in use were approved based on clinical trials conducted mainly on men. This increases the chances that women will be inappropriately medicated and negatively impacted, causing adverse drug events. The financial cost of adverse drug events is calculated at €79 billion annually in the EU27, of which **€52 billion can be attributed to adverse drug events amongst female patients**. The demographic cost is 197,000 deaths per annum of which up to 130,000 are likely to be female. The study recommends that policymakers should **mandate the collection of crucial sex and gender-disaggregated data in all pharmaceutical and other trials** that involve a human-targeted bio-reactive. This is already the case in the United States.



The cost to society of common female medical issues has been calculated. **Migraines** affect 43% of women, and the cost of female migraine treatment amounts to €49.3 billion per annum in the EU27. Between 2 -7 workdays per annum are lost by female migraine sufferers, amounting to between 226 million and 791 million lost workdays (with labour costs of between €45.5 billion - €158.2 billion) across the EU. **Endometriosis** is one of the most debilitating and poorly understood diseases that women suffer from and is estimated to affect 28.8 million women in the EU27. Endometriosis in the EU27 costs up to €252 billion. For 68% of women suffering from endometriosis, there is an average of 7.2 hours (€180 labour cost) per week lost due to symptoms, which amounts to €129 billion per year.

IN THE EU, MIGRAINES AND ENDOMETRIOSIS ALONE HAVE A TOTAL COST OF €301.3 BILLION EVERY YEAR.

Menstrual-related symptoms (MRS) lead to both absenteeism (missing work) and presenteeism (productivity issues due to working while unwell). MRS cause €53.8 billion in lost productivity per annum in the EU27. **Maternity** has an impact on employment, promotion, pay, benefits, and pensions, which results in falling birth rates. Addressing and eliminating the maternity impact may well be the key to long-term societal and economic sustainability. **Peri-menopause and menopause** cost the EU27 an estimated €17.3 billion per annum. During their whole life cycle, women increasingly report worse health status and **pain** than men and suffer from a higher burden of non-fatal and debilitating conditions, such as heavy periods, pregnancy, endometriosis, and as they age, menopausal symptoms, arthritis, depression, anxiety, and mobility problems. The cost of pain in the EU27 is calculated at €63.4 billion, and the annual cost of female pain management is €32.4 billion. An estimate of €9.1 billion in lost productivity and a loss of 45.6 million workdays (9.1 million employee years) per annum was found.

In addition, **misdiagnosis** of women – sometimes even with the same symptoms as men – is common: women are disproportionately and inappropriately prescribed mental health support which solves neither the cause nor the effect of the true issue, whilst men are referred to specialists. The cost to the woman is elevated resulting from longer suffering, loss of income, reduced career opportunities, and other indirect costs.

Mental health issues affect about 84 million people across the EU. **The total cost of mental ill-health in the EU28 was estimated at more than 4% of GDP (more than €600 billion)**.

Future-proofing medicine

Technological developments such as telemedicine, pharmacogenomics, artificial intelligence and the 3D printing of drugs represent exciting steps forward for medicine, but caution is required. Emerging technologies must not be populated with data that is outdated, biased, or inappropriate for purpose, as their use would be suboptimal and potentially fatal to patients.

WITH THE STEEP RISE IN DATA USE FOR MEDICAL INTERVENTIONS, IT IS URGENT TO ENSURE BIASES ARE NOT TRANSLATED INTO THIS DATA.

The key to this is 1) **Promote research** that focuses on understanding and addressing sex and gender differences in healthcare outcomes, treatment options, and disease prevalence; 2) **Collect and analyse disaggregated data** to identify patterns, trends, and areas where progress is being made or where further action is required; 3) **Require sex and gender appropriate approaches** in existing and future medical curricula, policies, and clinical practices to create a more inclusive and equitable healthcare system.

The journey towards sex and gender equality in medicine requires a multifaceted approach that involves stakeholders at all levels. By acknowledging and addressing the complex factors that contribute to sex and gender inequality, we can create a more inclusive, diverse, and equitable healthcare system that benefits all patients and supports the professional growth and development of medical professionals, regardless of their sex and gender.

C4EB CALLS FOR DRIVING DIVERSITY AND EQUALITY IN STEM AND MEDICAL EDUCATION BY ELIMINATING BIASES IN EDUCATIONAL AND SUPPORT MATERIALS AND PROMOTING EQUAL OPPORTUNITIES FOR WOMEN.

The report identifies key intervention points to **reduce or eliminate sex and gender bias** from medical curricula and practices, but also from the healthcare workspace as discrimination in medical professions has repercussions on the quality of care delivered. For example, early intervention could target the elimination of bias in educational materials and teaching mechanisms, and clear workplace policies covering the entire lifecycle of a woman are of utmost importance.

BY WORKING TOGETHER, WE CAN ENSURE THAT THE MEDICAL PROFESSION REFLECTS THE DIVERSITY OF THE COMMUNITIES IT SERVES AND PROVIDES HIGH-QUALITY, EQUITABLE CARE FOR EVERY-BODY.

Our 11 policy proposals

The report closes with **11 concrete, targeted, and fact-based policy proposals** to EU policymakers to improve healthcare for women across Europe, with tremendous gain in terms of GDP growth, thereby reducing the economic burden of poorer quality healthcare for women. These include:

- The creation of a specific Women's Healthcare Strategy for Europe.
- Require the provision of comprehensive disaggregated results data on gender, sex and age in the approval process of all medical products, processes, procedures, techniques, or devices for sale and use in the EU.
- Increased and targeted EU funding is made available for research into female-specific medical, social, and employment issues.
- Include specific provisions in EU and national legislation on Artificial Intelligence requiring the identification, prevention, and elimination of sex, gender and other biases in the models, logic, and operation of systems in medicine and related fields.
- Identify, quantify, and address systemic barriers that contribute to sex and gender inequality in medicine, such as sex and gender pay gaps, unequal access to career advancement opportunities, and biased recruitment and promotion practices.

This report identified that **billions of euros are lost** through gender inequality in healthcare every year.

By adopting a comprehensive and collaborative approach to addressing sex and gender inequality in medicine, **we can create a more inclusive and equitable healthcare system** that serves the needs of all patients and supports the professional growth of medical professionals, regardless of their sex and gender, whilst saving incredible amounts.

Women's health requires urgent action.

Treating women appropriately is not only good for women, but good for the economy. Important societal gains are possible. Implementable solutions exist.

Contents

Introduction

In 1849, a letter to the New England Journal of Medicine, after the award of the first female US medical degree to Miss Blackwell[1] stated, **"it is much to be regretted that she has been induced to depart from the appropriate sphere of her own sex, and led to aspire to honours and duties, which by the order of nature and the common consent of the world devolve alone upon men"**[2].

The journal editor replied, **"No law prevents a woman from occupying and cultivating any of the three great fields of medicine.... but there are obstacles nevertheless, much more subtle and powerful than law"**[3].

Despite huge strides in establishing equality and equity in medicine many of those barriers and biases remain stubbornly engrained and consistently powerful today.

Key amongst these is sex and gender. The lack of the consistent and mandated inclusion of sex and gender as core variables in all aspects of medical activity cause biased information, unequal access, poor consideration, inappropriate care, and poor outcomes for the 51.1% [4] of the EU population that are women. In the report, we use sex in a binary biological fashion (Female – Male) and gender in a sociological fashion (identification and self-identification to a role in society). Costs are represented in euros.

This study focuses on sex and gender discrimination and inequality in medical processes, protocols, and practices. Its goal is to identify the causes, quantify costs, identify consequences, and illustrate more sex and gender-appropriate approaches and outcomes across medicine.

It uses data from many sources across the globe. This is important as medicine and its practices have transnational implications and impacts as has been evident in the Covid pandemic. Where current data is available from EU sources this is given priority. A significant proportion of input is drawn from US research and studies as it is a single integrated medical market (the EU is not) and rich in sex and gender-disaggregated data. The United Kingdom, Australian, Chinese, and other national sources are also included where these provide illustrative trends, outcomes, or emerging impacts.

The report examines a selection of key areas where sex and gender discrimination and inequality against women incur high levels of additional medical, economic, social, and personal costs. Such costs are indicative.

We use the following baseline 2019 EU 28 demographic and costing data in the calculations[5]. *(At the time of writing post-Brexit data are not available for the EU 27).*

1. The first is the real population of EU 28 women in 3 categories (0-14 years 39 million, 15 – 64 years 168 million, 65+ 56 million).
2. The second is data on EU 28 women's fertility status. This is done to allow conditions and costs that are specifically related to the fertility stages of a woman to be calculated. These stages are (likely Fertile (Phase/ life stage) of women between 15 – 54 years 134 million, and likely Post fertile (Phase/ life stage) of women 55+ 92 million). Prepubescent girls have not been included as sex-related pediatric health issues in this group, since they are a statistical rarity.
3. The third set of data is used for the EU 28 labour force participation of women. These data allow calculations on conditions that impact female labour force participation, productivity, and social costs. 68% of women aged between 15 and 64 are in the labour force and for

women aged 65+, the rate is 60%. This means that there are 114 million women aged 15 – 64 in the EU 28 labour force and 34 million women aged 65% in the labour force. There are 91 million fertile female workers and 61 million post fertile women workers in the EU labour force.

4. The number of hours worked per day is averaged to 8. The labour cost per hour is set at €25 and the number of work weeks per year is set at 37 based on EU figures[6].

In 2019 the total annual amount of direct and indirect medical costs to the EU was over € 4.76 trillion or close to 30% of the EU GDP. This consists of a 9.9% GDP [7] spend on direct medical costs and an indirect cost (lost earnings and production) multiplier of 2.4 times direct costs. Unfortunately, sex and gender-disaggregated cost and impact information in medicine remains the exception rather than a mandated EU rule. This has somewhat limited the EU data used in this study.

Post-Covid, the direct and indirect costs of health care will be higher as the residual and emerging impact of the pandemic such as long Covid, increased cardiovascular disease, and reproductive and mental health issues must be managed. Any reappraisal of health care components this entails provides an opportunity to address discrimination and inequality issues that exist due to rigid organisational and professional structures, conventional practices, sub-standard processes, bias, and a lack of political will to deal with known, costly, and deadly inefficiencies.

Despite undeniable evidence of the negative medical impact of sex and gender blindness and inappropriateness, discrimination and inequality against women are as stark, startling, costly, and fatal as they were in 1849.

There is no defensible reason why this should remain so. We will illustrate why.

Sex and Gender inequality in medicine

In examining sex and gender inequality in medicine it is useful to look at it from two different aspects. The first is **Tenure,** which will detail among other things sex and gender issues in education, entry, participation, employment, and representation in medical stakeholders. These manifest themselves in underrepresentation in the management of medicine, reduced influence on the training and protocols within medicine, overt and implicit bias towards women practitioners, and reduced lifetime rewards from medical practice.

The second is **Treatment**, this part examined sex and gender inequalities that exist in modes of health care access, behaviours, processes, procedures, and outcomes.

Both will be examined for causality, consequences, and costs of inequality plus viable corrective policies and actions.

Medical Tenure

General Discrimination

The EU defines sex equality as a female representation of more than 40% in an occupation or position. In 2021 the OECD published research[8] showing that in 2000 that only 12 out of the 22 EU countries had 40% or more female doctors. By 2019 just one country (Luxembourg) failed to reach the 40% threshold. Estonia and Latvia both had 74% of female doctors.

However, such statistics are simplistic misrepresentations. They only show a mathematical indication of equality. They do not and cannot provide insights into the dynamic career-long experience-based sex and gender-related discriminations, and inequities in medicine, its processes, and its organisational and professional structures.

The Nature Salary Survey 2021[9] found that 68% of women experienced discrimination in the health care, biomedical and clinical sectors. During their careers, 94% of female respondents stated they experienced sex and or gender discrimination, 89% sexual harassment, 72% Ageism, 71% religious discrimination, 69% bullying, and 67% power imbalances. Only in racial and sexual orientation did men encounter greater relative levels of discrimination. During their careers, women also experience changes in and higher levels of discrimination such as bullying in their early careers and ageism in their late careers.

Stem education discrimination

Discrimination and inequality are common in STEM (Science, technology, engineering, and mathematics) and medical education.[10]

In research carried out in 2021[11] 15% of women in US medical schools reported recurrent multiple discrimination, 10% single discrimination, and 26% isolated infrequent discrimination. This study also looked deeply into intersectional (multiple concurrent) discriminations in medical education. In a similar type of study[12] in Sweden 53% of female medical students in pre-clinical education phases suffered from favouritism, 41% suffered from sex or gender discrimination, and 25% from intrusive or

unwelcome acts. In the clinical phases of their education, 23% suffered from favouritism, 22% from sex or gender discrimination, and 21% from intrusive or unwelcome acts. The same report showed that incidents, where the perpetrators were medical doctors, rose 500% between 2002 and 2013. In STEM education[13] girls and women are systematically tracked away from science and math throughout their education, limiting their access, preparation, and opportunities to go into these fields as adults. This has serious future career implications for women in increasingly computerised and technology-rich medical and other economic ecosystems.

The materials and teaching practices used in medical education are key vectors of discriminatory language, perception, convention, and action which impact processes, procedures, and practices. Despite increased attention to sex and gender issues in medicine, the visual representation of sex and gender in medical curricula continues to be male-gender-biased. The male-biased representations in medical textbooks provide inadequate and unrealistic information to students[14]. The representation of gender in images from textbooks remains predominantly male except within sex-specific sections. In addition, other forms of bias exist such as visualization of stereotypically gendered emotions, roles, and settings, a lack of ethnic, age, and body type diversity, and a strong binary link between sex and gender. Due to its pervasive impact, the removal of bias and discriminatory content from all medical education materials and sources should be a key strategic objective of the medical profession.

Medical Speciality discrimination

Distinct sex and or gender differences can be seen across medical specialities after graduation. Student motivations for choosing a speciality differ between men and women. Male students stated that the top three influencing factors were personal interest, future job prospects for the chosen speciality, and job opportunities in academic medicine[15]. For women, the 3 strongest influencing factors were personal interest, speciality specific knowledge and skills, and a sense of achievement. Salary ranked in the top 10 influences only for men. Work-life balance ranked in the top 10 influences only for women.

The choice of a speciality is made during medical education. Research[16] published in the USA in 2021 showed that only 27% of medical students graduate in the speciality that they first chose. 49% changed their speciality in the course of their education.

Post-graduation the extent of sex and gender differences in specialities becomes starkly apparent. In 2019, a US analysis[17] of the difference in the sex and gender balance in 47 specialities found that women represented only 36% of specialist practitioners.

The overall bias toward men across all 47 specialities is 27%. Only 16 of the 47 specialities reached the 40% equality threshold (Paediatrics 64%, Obstetrics and Gynaecology, Paediatric Haematology/Oncology, Child and Adolescent Psychiatry, Geriatric Medicine, Internal Medicine/Paediatrics, Neonatal-Perinatal Medicine, Endocrinology, Diabetes, and Metabolism, Paediatric Anaesthesiology (Anaesthesiology), Dermatology, Paediatric Critical Care Medicine, Rheumatology, Infectious Diseases, Family Medicine/General Practice, Allergy, and Immunology, Psychiatry 40%). Women outnumbered men in only 10 specialities (Dermatology, Endocrinology, Diabetes, Metabolism, Paediatric Anaesthesiology (Anaesthesiology), Neonatal-Perinatal Medicine, Internal Medicine/Paediatrics, Geriatric Medicine, Child, and Adolescent Psychiatry, Paediatric

Haematology/Oncology, obstetrics and Gynaecology, and Paediatrics). The largest sex and gender differences in favour of men were found in surgical specialities (Orthopaedic Surgery, Sports Medicine (Orthopaedic Surgery), Interventional Cardiology, Thoracic Surgery, and Neurological Surgery). The male ratio in these was found to be 80% and above.

The reasons for such imbalances in surgical specialities were examined in 2021 research[18] from Australia. This found deep systemic, procedural, and behavioural discrimination against women in surgical specialities. Key issues that emerged were: harassment, insufficient support, negative perceptions of women, lower levels of respect, exclusion, conforming to male standards, higher expectations, stereotyping, and work-life balance attitudes.

It is interesting to note that these issues are not unique to surgical specialities but are societally pervasive and consistently listed as key sex and or gender discriminatory attitudes and practices across all aspects of medicine and the broader economy.

Pay gaps

Once qualified sex and gender pay inequality becomes an issue.

Eurostat data from 2020 illustrates the change in the sex and gender pay gap in human health and social work activities between 2010 and 2020. For 19 of the EU member states the sex and gender pay gap fell. The largest fall was in Hungary and the smallest in Bulgaria. For the remaining 8 Member States (Slovakia, France, Romania, Netherlands, Austria, Lithuania, Malta, and Latvia) the gender pay gap widened. Latvia had the highest % rise and Slovakia the lowest[19].

The sex and gender pay gap is pervasive across the economy. 2019 UK research looked at the change in graduates' earnings by sex and or gender in years 1,3,5 and 10 after graduation. A 7% gap had opened by the end of year 1 and this grew to 24% by year 10. The cumulative growth in male earnings were 68% and for women's earnings just 36% in the study period.

In the USA specific research[20] into the sex and gender pay gap in 40 medical specialities found that women's pay exceeded that of males in none of them. The cumulative sex and gender pay gap over similar career profiles amounted to 25% or over €1.91 million. The gap was found to be the lowest in specialities where women have a significant presence in the profession such as paediatric rheumatology 8%, Haematology 10%, and paediatric infectious diseases 10%. The highest gap was in Oral and Maxillofacial oncology at 23%. It also found that the point of peak earnings was 49 years for men and 37 years for women. This has implications for career earnings and pensions.

Nursing is predominantly a female profession yet women are paid less than men in nursing. The Royal College of Nursing in the United Kingdom published a study on sex and gender pay in UK nursing in March 2022. This stated that the nursing profession in the UK consisted of 75% women and 25% male nurses. The mean pay gap between men and women fell from 27% in 2010 to 7.8% in 2018. A key reason provided for the pay gap was the far higher numbers of men in the top management and higher-earning segments of nursing. Similar research in the US found that female nurses earned on average €5720 a year less than male nurses of similar grades and skills[21].

A further pay gap is seen between childless women and those who have children during their careers. A 2016 research[22]by the TUC / IPPR found that by the age of 42, mothers who are in full-time work are earning 11% less than full-time women without children. The motherhood pay penalty was found to be closely associated with mothers who had their first child when they were under 33. Women who became mothers at a younger age earn 15% less than full-time women who hadn't had children by the age of 42. The pay gap between childless women and men was 12%.

The Covid pandemic has increased the STEM sex and gender pay gap in Europe, the US, and the UK. The 2022 SRG report[23] on global science employment found that the sex and gender pay gap in STEM in 2021 had risen to 25% in the UK, 17% in the US, and 16% in Europe. The EU sex and gender pay gap was 13% in 2020[24].

Addressing the sex and gender pay gap in medicine or any sector of the economy is problematic. Women are underrepresented in the higher-paying middle and upper-management structures of many sectors. In research done in 2020[25], the entry-level percentage of women was 58% but the percentage of women in senior management positions was only 14%. This difference causes part of the wage gap due to higher pay levels in higher management positions.

In the same research that looked at annual reviews, women outscored men by 7.3% in performance criteria but their score for management potential was 8.3% lower than for men. This can effectively filter women out of the promotion process which remains strongly biased against performance-based promotion. Further research[26] in 2022 into annual and performance reviews identified significant differences which showed the sex and gender balance in a department had a significant impact on the outcomes. Review formats and processes that use biased language can cause results to be highly inaccurate. Making review processes unbiased is not difficult and an easy way to start removing sex and gender and other biases.

There is also emerging evidence that reductions in the sex and gender pay gap are due more to slower relative rises in male compensation than significant upward adjustments in female pay. Pay transparency is often touted as a method by which to reduce the sex and gender pay gap.

The EU Commission and EU Parliament have published a pay transparency proposal to drive sex and gender pay equality. However, the EU proposal has issues[27]. It fails to include businesses and organisations with less than 250 employees. These account for 67% of all EU workers. The impact assessment of the proposal[28] also found that the outcome of the proposal would only reduce pay inequality by 1% to 1.5%. However, research[29] in 2020 showed that pay transparency led to a 2% to 7% reduction in the influences on academic pay rises of items such as reviews, published articles, grants gained, books published, and patents.

The importance of eliminating pay inequality is seen in its impact across society. According to a European Institute for Gender Equality report[30] on the impact of closing the pay gap would increase the EU GDP per capita by 6.1 to 9.6%, which amounts to €1.95 to €3.15 trillion by 2050. It would add 10.5 million jobs, and impact the balance of trade by increasing exports by 0.7% and reducing imports by 1.2%. Most importantly it would significantly reduce female and child poverty whilst also improving women's life opportunities.

Professional and patient behaviour

Once in the medical profession violence and inappropriate behaviour by both practitioners and patients is an issue.

A 2014 survey conducted by the Chinese Medical Doctor Association (CMDA)[31] found that 60% of medical professionals surveyed had faced verbal abuse from patients and their relatives and 13% of the professionals had been physically assaulted and harmed. A 2018 American College of Emergency Physicians survey showed that more than 47% of E.R. doctors reported work abuse. Patient assaults accounted for 97% of the reported abuse[32]. In a 2019 survey in Australia, it was found that since 2016 there was a 48% increase in assaults against nurses in Queensland and 44% in New South Wales[33].

The US Bureau of Labor Statistics found in 2020 that the intentional injury rate for hospital employees was five times higher than the national rate of all other industries[34]. A 2020 research[35] in the US reported on the types of violence perpetrated against healthcare workers and facilities. The main categories were disorderly conduct 28%, assault 11%, theft and burglary 8.2% 7%, vandalism 2%, and violent crime (murder, rape, robbery, and aggravated assault) 1.4%.

In addition to patient-perpetrated violence, there is violence and discrimination that occurs between colleagues in medical settings.

A revealing 2011 study[36] from the US reports that an average of 2.4 nurses leave a US medical facility each year due to disruptive behaviour by a physician. It also reported that 93% of nurses had witnessed disruptive behaviour such as threats *[with and without surgical instruments]*, physical abuse, inappropriate words or actions, abuse of position and power, etc. It also reported that 30% of nurses had a colleague who left due to being subjected to those or other inappropriate behaviours.

Despite the prevalence of violence against healthcare workers which increased during the Covid pandemic37 only 20 out of 55 countries (37%) of countries in the WHO State of the world's nursing 2020 report[38] had measures to prevent attacks on health workers. Europe had the lowest percentage at 26%.

Medical workplace violence is a structural problem rooted in social, economic, organisational, power relationships, and cultural factors. It disproportionately impacts women who make up over 89% of the nurses who in turn make up the majority of health care workers. The consequence of such violence is higher attrition rates in medical personnel, imposes added costs for recruitment and training, impacts on personal well-being and mental health, high legal costs, and the need to implement extensive and expensive prevention and protection policies, procedures, and mechanisms.

Attrition of medical personnel is costly. The medical training and recruitment costs of replacement staff to the state are considerable. In the United Kingdom, doctors' training costs over €186,000[39], nurses' training costs (4-year course) can amount to over €44,000, and the recruitment and onboarding costs for a foreign nurse are over €13,000[40]. In addition, the costs of litigation, insurance coverage, and worker compensation add to the overall costs of running a health service or institution.

Publishing and Editing

Publishing academic and applied research is a key influencer of knowledge and career advancement in the medical field. Where women are underrepresented in the creation and editing of educational and research material essential insights into sex and gender implications of the outputs can reduce opportunities for medical process improvement, and the costs of treatment. It also maintains or reinforces existing costly sex and gender biases.

Women are largely under-represented as participants in past and present biomedical research. In addition, the results of androcentric studies were generalized to guidelines and treatments used today. The lack of evidence from female patients may result in delays in treatment, application of inappropriate, ineffective, or harmful treatments; or the withholding of effective treatments. Statistics published by the World Intellectual Property Organization (WIPO)[41] showed that only 3 patent categories (Biotechnology 53%, Pharmaceuticals 52%, and Organic fine chemistry 49%) had over 40% a named female researcher on the patent application. The Nature Salary Survey 2021 looked at Funding for female researchers in early, mid, and late-career phases. 42% of female researchers stated there was unequal research funding in the early and mid-career phases. In March 2022 research titled "The Under-representation and Stagnation of Female, Black, and Hispanic Authorship"[42] looked at the sex and gender balance in 461.136 unique articles between 1883 and 2020. The articles were drawn from the Journal of the American Medical Association (JAMA) and the New England Journal of Medicine (NEJM). In the NEJM female first authorship peaked at 28.2% in 2002 and its pace of growth has slowed to 0.03% per year. At that rate, it will take 750 years for female authorship to reach 50%. For the JAMA female authorship peaked at 38.1% in 2011. It had an annual average female authorship between 2000 and 2019 of 31.6%. The rate of annual change has been 0.16% since 2000 which implies that it will take 75 years for its female authorship to reach 50%.

Research[43] into the sex and gender balance in editorial boards and editors-in-chief found that only 28% of members of 125 paediatric journals were women. The Netherlands had the highest number of women members at 32% and Germany the lowest at 18%. The overall EU balance was 28% women and 72% male. In 2022 research[44] on sex and gender balance in editorial boards for psychology journals it was reported that there was a 40% female to 60% male balance. In Neuroscience journals the balance was 30% female to 70% male.

Such editorial sex and gender imbalances in critical educational and other knowledge sources have an important negative impact on the alignment of educational materials to meet female healthcare needs and prevent the emergence of sex and gender-appropriate health care.

Data science discrimination

Data technologies (telemedicine, Artificial Intelligence, Machine Learning, Algorithms, Quantum computing) are playing an increasingly important role in the entire medical lifecycle from research to treatment. The software and logic embedded in the medical tools (software and hardware) undergo code reviews to ensure they are fit for purpose. Ensuring that these are rigorously checked to remove sex and gender and other biases is essential to optimising their efficiency and appropriateness in medical practice. However, 2022 research[45] in the United States found that women were 32% more likely to have their code reviews questioned or rejected. Older experienced code reviewers (50 – 59 years old) were 279% more likely to have their reviews challenged compared to the challenge norm.

This is a rate twice as high as that for younger reviewers (30 – 34). The importance of this is fourfold: 1) There is the danger of existing sex and gender bias being codified into emerging products, services, and processes that will be core to medical care in the future. 2) challenged reviews must be reworked by the reviewer. This disproportionately impacts women and older reviewers who tend to be paid less and lowers their productivity and income. 3) There is the risk of embedding sex and gender discrimination and 4) the emergence of a new sex and gender gap in future data-intense medical science and disciplines.

Structural and power discrimination

In 2021 medical organisations and power structures remain stubbornly Male, Pale, and Stale when ideally they should be Open, Inclusive, and Representative. Achieving age, sex, racial, and gender equality and equity in the participation and exercise of power in the medical management structures is the key to rectifying specific and intersectional inequality and inequity. In the Nature Salary survey 2021[46], 94% of women respondents in the Health care, biomedical or clinical fields reported they had suffered some form of sex and or gender discrimination and inequality. In the same survey, 67% of the respondents who were women stated they were negatively impacted by power imbalances at work.

The Global Health 50/50 Report 2020[47] examined sex and gender-related policies in health organisations. In 200 organisations across 10 health sectors, it was found that 75% had a policy commitment to sex equality. It also found that only 35% had a definition of sex or gender, 38% had sex-disaggregated reporting, 27% had policies on top management sex and or gender parity and only 14% had board diversity and inclusiveness policies. The same research found that faith-based health organisations had no female CEOs and regional bodies had no female board chairs. The Biomedical Engineering Society carried out research in 2020[48] into the perceived barriers to women gaining more senior leadership positions in their companies. This found that 75% of women respondents said that exclusion from influence and communication networks was key, 57% said stereotyping and bias, and 49% stated a lack of commitment to sex and or gender equality was the major issue.

These and many other pieces of research illustrate the pervasive nature of sex, gender, and intersectional bias and inequality across the management structures of the medical, STEM (Science, Technology, Engineering, Maths), and general education.

Subtle discrimination

Even when women are the best in a field, inequality against them is evident in the award of accolades and awards. This is very important because the lack of female role models, recognised leaders, and mentors consistently emerge as negatively influencing girls and women before and after entering STEM and medical specialities.

Take the Nobel Award as an example. In no Nobel prize category did women equal or exceed male recipients.[49] Between 1901 and 2021 only 58 women were recipients of the 59 awards (6%) (Marie Curie won 2). In the same period, 888 (94%) awards have been made to men in all categories. Things are no more balanced in awards for Physiology or Medicine. Here the percentage of women recipients is again 6% and 94% of men. When looking at the top scientific awards, research[50] has shown that the sex and gender gap has closed in the period between 2001 when only 6% of the top awards went to

women. By 2019 it had risen to 19%. In the same period, 22 (16%) of the 141 available awards (two of which are named after women) have never been awarded to a woman.

Women are overrepresented in prizes related to advocacy, education, mentoring, support, teaching, and public service but underrepresented in all other categories of research prizes.

The level of monetary reward for male and female recipients also shows a clear sex and gender gap. Women get 41% less in award amounts than men (Women € 60,979, Men €101,949). After winning an award women also suffer a prestige gap as their contributions are less accessed and cited in journals, publications, and other media. Such lack of recognition, reward, and prestige continues to hide the true past and present contributions of women to all scientific, technological, and medical fields from aspiring female scientists and medical practitioners. Some forms of sex and gender discrimination and inequality in medicine are subtle, pervasive, and often go unremarked by all but the victim.

One such is "untitling" which is the act of omitting professional titles. This is most commonly encountered by female professionals and it diminishes their perceived capability especially when their male counterparts are referred to with their titles in the same circumstance or situation[51]. A study[52] published in 2017, found that women introduced speakers by formal titles 96.2% of the time. When the introducer was a male addressing a female speaker, the use of titles went down to 49.2%. If the male introducer addressed a male speaker, the use of a title was up to 72%. A 2021 trawl[53] of Linkedin found that at least 70% of male doctors have their title and qualification readily visible within their name field on LinkedIn (prefixed "Dr" or suffixed "MD, PhD") while the same is true for only 20% of female doctors. A similar trawl[54] of Wikipedia found that currently, only 15% of those who actively contribute content to Wikipedia identify as a woman. Both examples illustrate what is called an emergent bias which is usually caused by the conscious under-participation of one or another party in an activity.

These subtle discriminatory practices reduce the perceived quality, status, and equality of women in the medical profession. This reinforces biases and implicit or explicit negative approaches to training, recruitment, personal advancement, and earnings. The key impact of this is the widespread devaluation and underutilisation of equally competent female medical professionals.

Medical Treatment

Life Stages and treatments

Three distinct stages can be defined in a woman's life as shown in the diagram below.

PrePuberty (~0 - 14)	Fertile years (~15 -54 years)	Peri/Post Menopause (~ 55+ Years)
Low levels of pediatric conditions that are Sex or gender related	High sex related differences in female medical needs and physiological conditions. Gender related medical treatments increase	Reduced sex related differences post menopause in female medical needs and physiological conditions . Increased vulnerability to cardi-vascular issues etc
Mental Health issues		
Sex and gender Interpersonal Violence		
Age related conditions not related to sex or gender		

Each of these has distinct medical requirements that are female sex specific and some may also have requirements for gender related interventions. However, due to common models and conventions in the medical field treatments and interventions often fail female patients sometimes with fatal results.

Adonis Model

When standing in front of a mirror few of us see a white, 22 – 30 years old, medium height, toned body, low BMI, mobile, straight, male, with no chronic health issues. This individual described above is what we call the Adonis model. It underpins and influences many assumptions, selection criteria, processes, protocols, and practices of modern medicine. It introduces biases on many levels of medical behaviour.

However, Adonis does not and cannot adequately or appropriately represent the morphologies, malaise, diagnosis, care, and support needs of the 51.1% of the EU 27 population that are women, the 53% of people who are overweight, 3% who are underweight the 10% who are of diverse races, orientation or the many other subgroups in society. As we will see the model's continued pre-eminence in modern medicine is inherently discriminatory, systemically suboptimal, costly, and too often severely detrimental to women.

The causes, access, frequency, interactions, and responses of women to medicine are different from men. This is mainly due to genetics, epigenetics, physiology, psychology, stereotyping, bias, access, geography, and socioeconomic situation[55]. It is greatly influenced by male medical practitioners' attitudes toward women[56]. Experience shows that when Cassandra (the woman who told the truth but was not believed) meets Adonis: Adonis wins, generally to the detriment of a women's health and well-being.

Drug trials and Adverse Drug Events

Drug trial participation in the past and today has a large sex and gender gap. This is an issue as there are distinct differences between male and female pharmacokinetics (the dynamic movements of foreign chemicals during their passage through the body) and pharmacodynamics (what a drug does to the body). Research in 2017 looked at global female participation in drug trials. This found that the average percentage of female participants was just over 40%[57].

Sex differences in pharmacokinetics and pharmacodynamics exist, persist, and change as people age. Metabolism, renal and hepatic function, body weight, age, and hormone types/levels are amongst the main differences between men and women and they change as individuals age. Drug trials are designed to identify the efficacy and safety of pharmaceuticals across the population.

Unrepresentative trials or those with only aggregated results are a risk to the general and specific constituents groups of the population, especially women. Research[58] into participation rates in the US found that women had a higher participation rate in trials related to Neurology, Immunology, musculoskeletal, trauma, and dermatology. Males dominate the participation rates in trials related to oncology, metabolism, nutrition, pulmonology, endocrinology, psychiatry, haematology, Nephrology, cardiology, and paediatrics. White participants accounted for 75% of all participants (62% of the US population) whilst 65+-year-olds accounted for 30% (16% of the US population)[59]. All drug trials should be mandated to provide sex and gender-disaggregated and age-sex/gender-disaggregated data in their results to ensure the substance can be appropriately prescribed within the population as is the case in the United States.

Drugs may have unintended consequences for the recipient. These are called Adverse Drug Events (ADE) which are defined as "an appreciably harmful or unpleasant reaction resulting from an intervention related to the use of a medicinal product". A 2016 Research[60] into the impact of ADE in the EU estimated that 5% of all hospital admissions EU are due to an ADE and that ADEs are the fifth leading cause of hospital death which amounts to an estimated 197,000 deaths[61] annually. The cost to the EU was calculated at € 79 billion per annum. The same report found that only between 1% and 10% of ADEs were reported. Women experience ADEs nearly twice as often as men. The role of sex as a biological factor in the causality of ADEs is poorly understood as most drugs currently in use were approved based on clinical trials conducted mainly on men which increases the chances that women will be inappropriately medicated and negatively impacted.

Moreover, 72% of studies on drug trials fail to provide sex and gender-disaggregated data which means that appropriate female dosages cannot be defined[62]. Such data and information is essential to preventing ADEs in women and should be mandated for collection in all pharmaceutical and other trials that involve a human targeted bio-reactive. The financial cost of ADE is calculated at €79 billion per annum in the EU 27 of which €52 billion can be attributed to ADE amongst female patients[63]. The demographic cost of ADE is 197,000 deaths per annum of which up to 130,000 are likely to be female.

Migraine

Migraines will affect 43% of women at some stage of their life. Women account for about 80% of the annual € 74 billion direct medical and lost labour costs of migraines in the US[64]. Migraine is the 4th leading cause of disability in women. They suffer migraine at 3 times the levels of men. Migraine is an "invisible " disease and is heavily stigmatised. This causes many individuals with migraine, regardless of sex and gender, to go undiagnosed or underreport symptoms. It is a disease that is still thought of as a "woman's disease" and therefore often delegitimized by the public, health care providers, and employers[65].

Migraine's primary characteristics are long-duration headaches, moderate to severe pain, nausea, vomiting, and sensitivity to light plus sound, an attack may last from 4 hours up to several days. In women, there is a strong link between migraine and monthly and life-stage natural hormonal changes. Migraine increases at menarche (when periods begin) and tends to peak during childbearing years and then usually decreases after menopause. Fluctuations in oestrogen levels have a strong correlation to the initiation of a migraine[66]. Male migraine sufferers often display elevated Estradiol (an oestrogen steroid hormone and the major female sex hormone) levels[67].

Migraine frequency increases before and during menopause and then tends to reduce in frequency and severity after it[68]. They are a major source of debilitation in women between 40 and 50 years[69]. Compared to men, women with migraine use more prescription medicine or a combination of prescription and over-the-counter medications to treat their attacks and are more likely to use complementary and alternative medicine approaches, in particular, acupuncture, homeopathy, massage, and yoga. Women are more likely than men to consult a healthcare professional and are more likely to seek migraine help in an emergency department or urgent care facility[70].

Because migraine is a chronic episodic disorder it impacts the health, social, familial, occupational, and academic life of a woman in all her life stages before and after menarche. However, most research uses age not the life stage of the woman to research migraine. This prevents an adequate and appropriate mapping of migraine symptomology to the life stage of the woman and thus the identification and prescription of the most effective and efficient treatment for that individual's life stage. This is important as responsiveness to treatment and speed of recovery speed are different in the life stages of a woman.

The cost of female migraine treatment amounts to €49.3 billion per annum in the EU 27. Over 113 million women in the EU 27 will suffer from migraines during their lives. The average annual treatment costs and lost productivity per female sufferer are €436. Between 2 and 7 work days per annum are lost by female migraine sufferers. This amounts to between 226 million work days (882 work years, labour costs €45.5 billion) and 791 million work days (3089 work years, labour costs €158.2 billion) across the EU[71].

Endometriosis

Endometriosis is one of the most debilitating and poorly understood diseases that women suffer from. Endometriosis is estimated to affect over 190 million women worldwide (EU 27 28.8 million) in their reproductive years. Studies show that endometriosis overtly affects approximately 11% of women in the general population whilst there is an additional 2 to 11% of asymptomatic women[72]. Using MRI scans a further 11% of women were found to have undiagnosed endometriosis. The disease is most common in those in their thirties and forties but can begin as early as 8 years old and persists after menopause. It affects women regardless of race or ethnicity or whether or not they have had children.

Endometriosis causes pain due to its tissue response to hormonal change (period bleeding), swelling, adhesions, organ binding, and physical activity. Endometriotic lesions can develop a nerve supply. This can create a direct and two-way interaction between lesions and the central nervous system that can produce a variety of individual differences in pain or even become independent of the disease itself. About 33% of women with infertility or subfertility have endometriosis whilst 40% of those with endometriosis are infertile[73].

The two factors that contribute most to the economic burden of endometriosis include healthcare costs and losses in productivity and income loss. A 2020 Swedish study of 400 endometriosis patients found the mean annual cost among all women was € 8,768 per woman. The direct healthcare cost of managing the disease was €4,282, while the indirect cost was €4,486. Absence from work was reported by 32% of the women, while 36% reported reduced time at work because of endometriosis[74]. The key medical failures in endometriosis are misdiagnosis and long delays in arriving at a correct

diagnosis. A third of women had consulted their GP six or more times before being correctly diagnosed. Nearly 75% of women receive one or more misdiagnoses before endometriosis is correctly identified.[75] Studies show an average diagnosis delay of 11.7 years in the United States, 8 years in the United Kingdom, 8 years in Spain, 7 – 10 years in Italy, 6.7 years in Norway, and 4 – 5 years in Belgium and Ireland. It was also found that on average women diagnosed with endometriosis waited 2.3 years after the onset of symptoms before seeking treatment.

There is no cure for endometriosis. Surgical intervention to reduce endometriotic lesions and adhesions is practiced but this has a high recurrence rate[76]. The general medical is that endometriosis is simply managed. The goal of such management is to provide pain relief, restrict its progression and restore or preserve fertility if possible.

Medical practitioner knowledge and practices were also found to be lacking. Half of the general healthcare providers surveyed in a 2013 study were unable to name three symptoms of endometriosis[77]. Healthcare providers are also likely to dismiss symptoms described by women as normal menstruation[78]. What the impact of earlier diagnosis would have on better management of the progression of endometriosis is unknown. However, the very large impact of early cancer diagnosis may prove a useful model for a radical reappraisal of the diagnostic protocols, assumptions, and medical interventions in treating endometriosis.

The total annual costs of endometriosis in the EU 27 amount to up to €252 billion based on costs provided in Swedish research[79]. Symptomatic endometriosis affects 28.8 million women in the EU 27. For 68% (19.6 million) of those suffering symptoms lead to work absences or presenteeism. There is an average of 7.2 hours (€180 labour cost) per week lost due to symptoms[80]. That amounts to €129 billion per year.

Menstruation

The prevalence and the impact of Menstrual Related Symptoms (MRS) on women, society, and the economy demand a change in the way that menstrual symptoms are viewed, discussed, catered for, and treated. As it stands discussions about MRS are all too often taboo, especially in the work environment. Around 80% of women experience period pain (dysmenorrhoea) at some stage of their life between their early teens and the end of menopause[81]. In 5% to 10% of women, the pain is severe enough to disrupt their social and economic activities[82].

There are two types of dysmenorrhoea. Primary dysmenorrhoea is the most common type of painful period. It occurs mainly in women in their teens and early 20s. It is not associated with any underlying problem of the womb (uterus) or pelvis. Secondary dysmenorrhoea is less common and is more likely to occur in women in their 30s and 40s and is associated with a problem of the womb or pelvis[83].

Approaching their period women can suffer from Premenstrual Syndrome (PMS) symptoms which may start between 1 – 2 weeks before their period begins. During their period many women suffer low to moderate pain and some or all of the symptoms associated with PMS. More severe pain may be an indication of an underlying issue, especially in women over 30. Such conditions include endometriosis, uterine infections, fibroids, pelvic congestion syndrome, pelvic inflammatory disease (PID), and the rare conditions of adenomyosis and cervical stenosis[84].

MRS can place considerable financial burdens on women, their families, and society. These costs include costs of visits to the doctor, over-the-counter drugs, medical or surgical treatment, lost income, lost productivity, and the costs of poor personal well-being.

Economically the results of productivity loss are the largest cost driver. These costs are defined as the costs of paid and unpaid production loss and the replacement of productive people due to illness or disability. These costs are caused by two types of productivity changes. The first is absenteeism which is defined as any failure to report for or remain at work as scheduled, regardless of the reason. The second is presenteeism which is defined as productivity issues due to workers coming to work while physically, mentally, or emotionally unwell. In such conditions, employees may not be able to fully perform their duties and are more likely to make mistakes on the job. It is increasingly seen as a larger problem than absenteeism as the number of workers working through illnesses is estimated to be much larger than those missing work for illness.

In 2017 research[85] carried out in the Netherlands with 32,748 women aged 15–45 years it was found that the average number of hours of presenteeism, 5.3 hours per week, was far greater than the number of hours of absenteeism, which was 1.1 hours per week. Younger women had significantly higher levels of lost productivity than their older counterparts and more severe MRS is associated with more absenteeism and presenteeism. The mean workdays lost per woman was 1.3 days per year. An average presenteeism productivity loss of 33% was found with a mean of 8.9 days of total lost productivity per year. Most women in the survey group had at one time or another consulted a medical practitioner due to MRS. 54.6% visited a doctor, 31% visited a general practitioner, and 14.4% a gynaecologist. 90.8% stated that the diagnosis they received was not for MRS. Where available 79.7% of women were positive about discussing MRS with a company doctor. For those women who called in sick to an employer because of their MRS, 20.1% told their employer that MRS was the reason, 46.4% only mentioned a symptom, 27.7% gave no reason, and 5.8% made up another reason.

Absenteeism and Presenteeism impose financial and personal burdens due to the costs of visits to the doctor, over-the-counter drugs, medical or surgical treatment, and personal activities and well-being. The report[86] looked into the actions women would like to see to assist them in managing MRS and their work life. 67.7% preferred more work flexibility during their periods, such as doing less physical work 32.1%, the ability to work from home 39.5%, more time for personal care 28.3%, and the ability to take a day off and make up for it later. 11.5% and 32.9% wished they could take a complete day off without any consequences. 27.2% saw no need to change the employer's existing policies.

A 2021 research report[87] from Spain introduces the very useful concept of menstrual inequality. This is defined using two dimensions:

1) A comparison to men and other non-menstruating people “the systematic and avoidable disparities in the access to healthcare, education, and knowledge, experiences of stigma and discrimination, the lack of research on the menstrual cycle and menstruation, and the barriers to social, community, political and economic participation based on having a menstrual cycle and menstruating”.
2) A consideration of women and people who menstruate as “the systematic and avoidable disparities between different populations in the access to menstrual healthcare, menstrual

education, and knowledge, products, services, and facilities for menstrual management, menstrual-related experiences of stigma and discrimination and barriers to social, community, political and economic participation".

The same report found that when women sought medical help they found health professionals usually only offered hormonal contraception to treat menstrual issues. Respondents felt frustrated and dismissed even after describing symptoms and how menstruation affected their daily lives. The report illustrates the importance of more accessible information, political awareness, training of medical professionals, continued research, and the implementation of policies for menstrual support and management in health care, businesses, and organisations. These would reduce MRS-related discrimination against women in all areas of society. In 2022 Spain introduced broad and highly progressive legislation on mensuration rights in work and education[88].

With the pervasive and damaging impact of MRS across society there may well be a justification for the introduction of MRS leave as a societal norm. This, on the evidence above, would have distinct benefits personally, socially, and economically for women and society. Menstrual Related Symptoms (MRS) cause €53.8 billion in lost productivity per annum in the EU 27. There are an estimated 13.4 million women between 15 -54 who suffer from Menstrual Related Symptoms (MRS). 9.1 million of these are in the labour force and lose an average of 6.4 work hours weekly due to absenteeism and presentism. Hourly labour cost is set at €25[89].

Maternity

Maternity requires severe adaptive transformations to a woman's physiology to provide appropriately for the developing foetus and its immediate postpartum requirements. All aspects of this challenge are a biological "stress test" for the mother's various organ systems, most predominantly the metabolic and cardiovascular systems[90].

Pre-pregnancy fertility treatment when required can be lengthy, physically and mentally traumatic for a woman. Some aspects of the transformation during pregnancy can have short and long-term postpartum implications for the woman including anxiety, diabetes, coronary issues, hypertension, renal disease, sight issues, and postpartum depression. These and other impacts of maternity (child care needs, family support, child healthcare…) also have implications for the postpartum quality of life and life opportunities for women.

Maternity-related career interruptions by women have a significant impact on their future career path, promotion, earnings, and pensions. It is also the key reason for career interruptions by women. Maternity pre and postnatal leave and protected return to employment are legally enshrined in all EU countries. In the EU the average maternity leave is set at 25 weeks in length (a range of 80 weeks possible in Sweden to 10 weeks in Portugal). EU paternity leave in comparison averages 2 weeks (Ranges from 9 weeks in Finland to none in Germany)[91]. The concept of sex and gender-neutral parental leave which is a combined allowance and transferrable between partners is gaining popularity in the EU. Research in 2013[92] into the employment return patterns 12 months postpartum in French hospitals showed that 95% of professionals and managers returned but only 57% of sales/service or manual workers. 82% of fixed-position employees returned compared to 60% of part-time employees. 25% of employees with low job satisfaction in all employee categories did not return

to work. The main reasons for not returning to work were postpartum depression 46%, hospitalisation of the mother in the 12 months postpartum 26%, caesarean section 22% or preterm birth 22%, and infant hospitalisation in the 12 months since birth 15%. The postnatal return of women to the workforce is now being researched in greater depth. In 2019 research[93] in the United Kingdom the prenatal employment status of women as compared to the postnatal employment status was examined. This found that of prenatal women in full-time employment 44% returned to full-time employment, 29% changed to part-time employment and 14% did not return to work. For prenatal women in part-time employment, 8% took up full-time employment, 50% remained in part-time employment and 28% did not return to work. Women also disproportionately leave the workforce in dual-earning partnerships. This is generally due to their lower pay and thus a lower impact on household earnings.

Maternity also impacts women over 50 who provide over 62% of informal unpaid child care. This reduced the ability of these women to participate fully in the labour force, reduces their life earnings, and if withdrawn would harm working mothers[94].

Pregnancy and maternity discrimination in work continues unabated. The pandemic increased the motherhood penalty across all measures. Women raising children pay this motherhood penalty in underemployment, slower career progression, lower lifetime earnings, and higher levels of post-menopause poverty due to the pensions gap. According to PWC, the pandemic added 31 hours of unpaid work onto women's working week[95]. According to the TUC in the United Kingdom, 71% of mothers who asked to be furloughed for childcare reasons had that request rejected. To manage these refusals 25% of mothers took annual leave for childcare reasons, 18% were forced to reduce their work hours and 7% took unpaid leave from work and received no income[96]. The OECD reports that mothers are more likely than fathers to report the presence of mental health issues such as anxiety and depression[97].

Maternity is the key to the maintenance of any society. That women are paying a high and growing motherhood penalty rather than receiving an appropriate motherhood premium is a perversion of logic. It is difficult if not impossible to quantify the lifetime penalty imposed on women as it is incurred in all realms of post-puberty life. What can be seen is the impact it has on employment, promotion, pay, benefits, and pensions. With falling birth rates addressing and eliminating it may well be the key to long-term societal and economic sustainability.

Menopause

Menopause is measured from a point 12 months after a woman's last period. In the years leading up to that women may have changes in their monthly cycles, hot flashes, or other symptoms. This is called the menopausal transition or perimenopause. The menopausal transition most often begins between ages 45 and 55. The average age is 51 years. Peri/menopause can last between 7 to 14 years. The duration is influenced by lifestyle factors such as smoking, age at perimenopause, race, and ethnicity[98].

During the menopausal transition, women endure many symptoms including hot flashes, trouble sleeping, pain during sex, moodiness, irritability, depression, and migraines. Menopause can also be caused by a hysterectomy or surgical removal of the ovaries if no post-surgery hormone replacement therapy is provided or accepted. After menopause, women become more vulnerable to heart

disease and osteoporosis[99]. Peri/menopausal women frequently find it difficult to speak to others about their concerns and are often not adequately supported by medical practitioners, many of who may lack the specialist knowledge to provide expert, personalised support to them. Only 37% of menopausal women feel comfortable speaking to a nurse or a doctor about their symptoms[100]. Peri/menopause occurs between 45–64 years old when many women are often at the peak of their careers. At work, only 0.6% of women felt comfortable speaking to their employer and there is a lack of clarity and consistency as to whether peri/menopause issues impact a woman's performance in the workplace is a disability or a sex discrimination matter.

Organizations should be aware that if a menopause sufferer is harassed or bullied at work this could amount to unlawful discrimination because of a protected characteristic, including age and sex. Equally, if a peri-menopausal or menopausal employee is put at a disadvantage or treated less favourably at work due to menopause-related absences this could amount to unlawful discrimination because of sex and gender ageism. A 2019 research commissioned by Health & Her® and carried out by Censuswide revealed that peri/menopause is estimated to cost the United Kingdom economy 14 million working days every year, or approximately £1.8 billion in GDP[101]. This represents 1.42 workdays per working woman per annum in the United Kingdom. The labour force impact found that an estimated 370,000 working women (8.5% of working women) between 50 and 64 stated that they have left, or considered leaving their career because they found that dealing with symptoms in the workplace is too difficult. Research by the Institute for Personnel and Development said that some women are forced to take long-term absences to manage symptoms: with an average of 32 weeks' leave from their career due to menopause[102]. 25% of women said that their relationships were affected leading to increased divorce rates in women over 50 with 65% of these divorces being initiated by women[103]. Such late-life divorces can impact a woman's long-term general health, wealth, savings, income, and pension receipts.

Sex and gender bias are evident in the research and treatment of menopause. This is seen in research and treatment processes and procedures that keep women from receiving the same treatment options for mid-and later-life loss of sex drive as men and treatments for other menopausal-related symptoms plus chronic diseases that develop from loss of important reproductive hormones[104]. A 2020 US report found reported that testosterone deficiencies in women, which is especially common in the years before and during menopause, may cause a wide variety of symptoms such as mood disorders, weight gain, cognitive impairment, insulin resistance/diabetes, low libido, and others. Despite these potentially life-changing symptoms, unlike for men, there are zero FDA-approved testosterone products or protocols for women. Instead, many women turn to hormonal specialists who can prescribe compounded testosterone[105].

Peri-menopause / menopause costs the EU 27 an estimated €17.3 billion per annum using the UK figure of 1.42 x 8 hour work days lost per annum for the 61 million 55+ years labour force participants in the EU 27 at a cost per hour of €25 per hour labour cost.

Pain

Chronic pain is defined as pain that persists for more than three months. It and non-chronic pain have a significant impact on patients, their families, employers, health services, and the wider economy. Chronic pain is estimated to cost over €476 billion (€142 per person) annually in the US. This is a higher

annual cost than heart disease, cancer, and diabetes[106]. In Europe, a recent estimate suggests that up to 40% of the European population experiences chronic back pain[107], and in Denmark, it is estimated that one million working days are lost per annum. This equated in Q3 2021 to 40% of a workday for every employed person in Denmark[108].

Pain is a deeply personal, highly individualized experience that is profoundly impacted by sex, gender, and age. It is not, unlike blood pressure, measured directly using instrumentation. Its measurement involves a patient telling a physician how intense their pain is. The physician uses this information and the patient's facial expressions or physical reactions to arrive at a pain level diagnosis using one of many pain level models used in medicine today. As such pain, and its diagnosis has many of the characteristics of an art and less of those of science. There is a pervasive sex and gender bias in the field of pain treatment. Women form the majority of medical graduates in the US but comprise only 15 – 16% of pain management practitioners[109].

A 2008 Canadian study found that the odds of a surgeon recommending knee replacement for knee osteoarthritis were 22 times higher for a male patient compared to an identical female patient[110]. Physician sex and gender have been found to influence perceptions of men and women in pain. It also influences pain treatment decisions such as medication prescriptions, invasive procedures, or referrals to psychology/psychiatry. A 2016 study found that pain clinicians and medical students rated female patients to have less pain and to be more likely to exaggerate pain, with men more likely to be recommended analgesics, while women were recommended for psychological treatment[111]. A 2021 research[112] of 27,000 individuals across 19 European countries found significant variation in sex and gender pain inequalities across European countries. At a pan-European level, a greater proportion of women (62.3%) reported pain than men (55.5%).

Women as they progress through life stages also increasingly report worse health status and pain than men and suffer from a higher burden of non-fatal and debilitating conditions, such as periods, pregnancy, endometriosis, menopause, arthritis, depression, anxiety, and mobility problems[113]. These sex and gender inequalities in pain lead to higher opioid use in women[114]. This places them at higher risk from the multiple side effects of opioid treatments (addiction, sleep disturbances, endocrine disorders, reduced immune function, and increased pain through opioid-induced nerve damage).

The cost of pain in the EU 27 is calculated (Using the US figure of €142 per person /annually) at €63.4 billion. The annual cost of female pain management is €32.4 billion. An estimate of €9.1 billion in lost productivity is arrived at by extrapolating the Danish findings over the female EU labour force of 114 million. This would represent a loss of 45.6 million work days (9.1 million employee years) per annum.

Violence against women

Violence against women (VAW) is a social phenomenon with extreme consequences for individual women, their children, and society. The term Violence Against Women (VAW)[115] includes any physical, sexual, emotional, or economic violence directed at women and girls by an intimate partner, family member, acquaintance, or stranger. It has immediate personal and potential transgenerational implications as it can have long-term psychological impacts on children and their present and future behaviour[116]. In 2002 the WHO estimated that female domestic violence and rape rank higher than cancer, motor vehicle accidents, war, and malaria in the global estimates of selected risk factors for

increased morbidity, disability, and mortality. They estimated that for women between 15 and 44 that 5% to 16% of healthy years of life are lost.

VAW is highly pervasive and costly to the EU in personal, social, and economic terms. In 2021 the European Institute for Gender Equality (EIGE) published a report[117] on the costs of sex and gender-based violence in the European Union. This extrapolated high-quality UK data across the EU 27 countries. This was used to present cost estimates for sex and gender-based violence and intimate partner violence in the EU-27. It arrived at an estimated annual cost of € 366 billion for sex and gender-based violence. 79% of such violence was carried out against women costing the EU €278 billion per annum. In a 2022 report published in The Lancet[118], data were obtained from 161 countries and areas, covering 90% of the global population of women and girls (15 years or older). This found that 27% of women over 15 years of age suffered physical or sexual violence and 13% in the 12 months before they were interviewed. Such violence starts early. 24% of women aged 15 - 19 years old and 26% of women between 19 -24 years had experienced sexual violence since they were 15. In 2021 a report[119] into violence against women by the WHO showed that in 2019 intimate partner violence (IPV) was suffered by 24% of women and non-intimate partner violence by 9.7% of women. The report also looked at the costs of such violence. The cost of human life was calculated to range between €3 million and €9 million depending on the calculation method. Various per-case costs were also reported. These ranged from €7,000 in the US to €22,000 in Tasmania depending on the calculation method used. The cost to the US economy of IPV was calculated at a minimum of 0.125% of GDP. The average cost across 19 US states of treating a rape case was reported at €7,000 with one fully inclusive calculation of all direct and indirect costs (physical treatment, mental treatment, productivity loss, income loss, judicial costs, personal emotional costs, etc) coming in at €90,000 per case.

What is evident is that violence against women must be addressed with more urgency. This needs to be done by changing the economic and sociocultural factors that explicitly or implicitly tolerate any form of violence and discrimination against women. This includes challenging social norms that implicitly or explicitly support male authority and control over women, eliminating any sanctioning or condoning of violence against women, reducing levels of childhood domestic and external exposure to violence, reforming out-of-date tolerances in family law, enhancing women's economic and legal rights, eliminating sex and gender inequalities in education and workplaces and addressing rising levels of sex and gender-focused violence depictions in online and offline media and pornography.

No studies have yet provided a complete picture of the full cost of sex and gender violence to victims, both in terms of direct and indirect costs across their lifespan. Research has also failed to examine intersectionality by examining varying personal, social, and economic impacts by race, ethnicity, age, sexual orientation, disability, socio-economic position, or geographic location. Such research is urgently needed to ensure that policymakers and practitioners have a more complete understanding of the costs of sex and gender abuse and then apply appropriate responses and remedies.

Extrapolating high-quality UK VAW data[120] across the EU 27 arrived at an estimated annual cost of € 366 billion for sex and gender-based violence. 79% of such violence was carried out against women costing the EU €278 billion per annum. This amounts to an average state cost of €1000 per woman in the EU 27 per year.

Mental Health

A mental illness is a condition that affects a person's thinking, feeling, behaviour, or mood. These conditions impact day-to-day living and may also affect the ability of the sufferer to relate to others[121]. Mental health is influenced by many factors, including genetic predisposition, socio-economic background, adverse childhood experiences, interpersonal violence, trauma, chronic medical conditions, or substance abuse. The most common mental conditions are Anxiety Disorders, Depression, Bipolar Disorder, Attention Deficit Hyperactivity Disorder (ADHD), Borderline Personality Disorder, Obsessive-Compulsive Disorder (OCD), Post-traumatic Stress Disorder (PTSD), Dissociative Disorders, Eating Disorders, Psychosis, Schizophrenia.

There are sex and gender differences in the prevalence of certain mental disorders. Women are more likely to have a diagnosis of major depression and anxiety. Men on the other hand are more have a diagnosis of substance abuse and antisocial personality disorder. Men and women are both diagnosed with post-traumatic stress disorder (PTSD). Women have a higher rate of PTSD diagnosis due to IPV, sexual assault, rape, and child sexual abuse. In men, the most common PTSD causes are violent experiences such as accidents, wars, and witnessing death. There is no significant sex and gender difference in the diagnosis rates for disorders such as schizophrenia, borderline personality disorder, and bipolar disorder. 50% of all lifetime mental illness begins by age 14, and 75% by age 24. Violence against the person has an impact on mental health even if it is only observed especially by the young. Early postpartum support for mothers can have a major beneficial impact on the brain development of the newborn infant. 2021 US research[122] into the impact of paid parental leave on the development of infants. This reported that infants whose mothers had paid leave were 7.39 times more likely to have increased activity of higher-frequency brain waves and a brain activity profile that reflects a more mature pattern of brain function. They were also found to be more likely to have better language and socioemotional skills during toddlerhood. It also found that mothers with paid leave had less physiological stress, were less likely to be re-hospitalized after discharge, less likely to have postpartum depression, more likely to breastfeed their infant, and were more sensitive and responsive to their infants. Paternity leave has also been shown to positively impact relationships within families, and that increased time between fathers and infants may help attune fathers to the needs of their infants and partners. Such early infant support is likely to have a potentially positive impact on the future mental health of the infant.

A 2022 study from the University of Toronto[123] which interviewed 17,739 respondents reported that over 22.5% of adults who were chronically exposed to parental domestic violence (PDV) as children developed major depressive disorder later in life. The rate for adults who were unexposed to PDV was 9.1%. 1 in 6 adults who witnessed PDV developed anxiety disorders, and over 26.8% later developed substance use disorders versus 19.2% of those without exposure to PDV. The study excluded respondents who had experienced childhood physical or sexual abuse. Lifetime mental issue rates across a population were estimated to be: anxiety disorders (28.8%), mood disorders (20.8%), impulse-control disorders (24.8%), substance use disorders (14.6%), and any disorder (46.4%)[124].

The OECD Health at a Glance Europe 2018 report[125] stated that mental health issues affect about 84 million people across the EU. The total costs of mental ill-health in the EU 28 were estimated at more than 4% of GDP (more than EUR 600 billion). The COVID-19 pandemic and its economic impact are

having ongoing implications for citizens. This is manifested in higher rates of stress, anxiety, and depression. Numerous studies have investigated the impact of the COVID-19 pandemic on healthcare workers in units dedicated to the care of COVID-19 patients, reporting high levels of anxiety, depression, burnout, insomnia, and psychological distress. Among health professionals, meta-analyses reveal a frequency of 12.2–36% for depression and 13–37% for anxiety. A recent review and meta-analysis conducted in October 2020 among healthcare workers revealed a frequency of 30.0% of anxiety, 31.1% of depression, 56.5% of acute stress, 20.2% of potential post-traumatic stress, and 44.0% of sleep disorders[126].

A 2020 US study[127] on the impact of Covid 19 lockdowns on women's mental health in the US reported that the negative mental health impact of lockdown orders is almost entirely driven by a negative effect on women. This contributed heavily to a widening of the existing sex and gender mental health gap by 66%. The results show that lockdown measures affect the mental health of women beyond their impact through increased financial worries and childcare responsibilities. Covid 19 impact on the medical profession and practitioners has been especially severe. A 2021 multinational research report[128] covering 1448 healthcare workers (HCWs). 51% were male and 49% female. Amongst the healthcare workers, 57.5% had depression, 42.0% had stress, and 59.1% had anxiety. Women working in a teaching hospital, and specialists had significantly higher depression and stress scores. Patients interviewed reported 19.2% having severe to extremely severe depression, 16.1% having stress, and 26.6% having anxiety. A French study[129] in 2020 researched a total of 4370 professionals from 77 hospitals across 73 Departments. The study had a majority of women respondents (81.7%), nurses accounted for 28.7%, physicians for 22.8%, and Non-medical staff 26.7%. The main findings are that 56.9% of all professionals were suffering from mental distress, and 21.2% had signs of PTSD more than one month after the peak of the first COVID-19 wave. Around 20% of professionals who participated in this study had clinical symptoms of both psychological distress and psychological trauma. A total of 56.9% of professionals presented psychological distress (56.7% among the medical/caregiving staff *vs*. 57.4% among the non-medical staff). Midwives were the most affected (69.4%), followed by professionals working in Quality, Health, Safety, and Environment (QHSE) (67.7%), while psychologists and those working in technical maintenance/computer networks had the lowest levels (respectively 46.9% and 46.9%). Comparisons between men and women and medical and non-medical staff did not show any significant difference in the average psychological distress scores.

It is therefore unsurprising that there is sex and gender inequality in mental health when the number and type of medical misdiagnoses that are made during women's unique stage of life conditions and transitions are taken to account. As has been shown earlier that in women's stages of life, misdiagnosis is common, physician knowledge is lacking, and ingrained bias is frequently exercised. Women are disproportionately and inappropriately prescribed mental health support which solves neither the cause nor the effect of the true malaise.

As such it has a double cost on society: one for the mental health support and treatment plus the cost of an eventual treatment of the true condition. The cost to the woman is elevated resulting from longer suffering, loss of income, reduced career opportunities, and other indirect costs. The total costs of mental ill-health in the EU 28 were estimated at more than 4% of GDP (more than EUR 600 billion).

Technology

The emerging role of Technology

The Covid 19 pandemic has fundamentally changed the technological landscape of medicine. The epidemic accelerated the use of technology in the analysis, support, and provision of medical services. It also drove the greatest single collection of consistent health data across Europe and the world. This will, for years to come be used to feed Artificial Intelligence (AI) supported research and analysis from which patterns of infection, symptoms, treatment, outcomes, and long-term impacts can be gleaned and considered in future policy and process planning. As the data is largely sex disaggregated this has the potential to significantly inform sex and gender-appropriate post covid medical research, policies, protocols, and procedures.

Telemedicine

The use of telemedicine has allowed remote initiation and continuity of patient care, consultation, and support. Telemedicine proved critical to maintaining public health services during the Covid pandemic. However, even post pandemic telemedicine offers greater accessibility, responsiveness, reduced travel, less cost, and flexible scheduling. All of these are key issues for women especially those with maternal, caring, distance, or work constraints. A report in 2020[130] found that Female patients and younger adults aged 18 to 44 are more likely to choose a telemedicine visit than male patients or patients of other ages. Patients of 65+ years were less likely to use telemedicine. Video or telephone telemedicine can offer patients access to a clinician without arranging for transportation or spending time in a waiting room, but little is known about patient characteristics associated with choosing between telemedicine or office visits.

However, a Mckinsey report from 2021[131] showed that doctors and patients have different opinions about telehealth and broader digital health engagement. 66% of physicians and 62% of patients said that telemedicine was more convenient but 64% of physicians said they found it personally inconvenient. 62% said they have returned to recommending in-person consultations and envisage telemedicine only accounting for 30% of their patient interactions in the future. This differs from patients of whom 40% said they intended to continue using telemedicine, and 55% of patients said they were more satisfied with telehealth/virtual care visits than with in-person appointments. 35% of patients are using other digital services, such as ordering prescriptions online and home delivery. 42% of these started using these services during the pandemic and plan to keep using them in the future. An additional 15 percent are interested in starting the use of digital medical services.

Pharmacogenomics

The field of pharmacogenomics (The study of the impact of genetics on drugs in an individual) is evolving rapidly. Men and women have different genomes and 99.5% of people have at least one change in their genome that if they receive a specific medicine will not work or will adversely affect them[132]. The availability of a personal genomic map included in a person's medical records can assist in guiding diagnosis, treatment, and monitoring of patients, especially women.

More than five million people in the UK get no pain relief from codeine because their genetic code does not contain or is deficient in the instructions for making the enzyme that breaks codeine down into morphine[133]. These individuals are CYP-2D6 deficient. Research in 2019 showed that

approximately twice as many women (9.5%) experienced adverse reactions compared to men (4.8%), suggesting that sex modifies the association between CYP2D6 phenotypes and response to codeine and tramadol[134]. One in 500 people have a genome issue that risks them losing their hearing if they take the antibiotic gentamicin[135]. Animal testing in 2018 found that females were more likely to be impacted than males. The degree of sex related differences was not included in the study[136]. As women are up to 50% more likely to be prescribed opioids[137] than men and their reactions to opioids are sex influenced it is important to have a far greater understanding of such differences at a general and personal level to ensure, that for all medications, more targeted, timely, appropriate, and effective treatment protocols for women are implemented. In the UK trials are being done that involve testing patients' DNA by using a blood or saliva sample before prescribing any of the 40 most prescribed drugs in the UK[138]. Their report says they already have the technology to roll out genetic testing to guide the use of 40 of them. Long-term such testing could be done at birth or become a routine check performed later in life.

Artificial Intelligence

Artificial intelligence will be crucial for incorporating female data and ensuring it is been taken into account in the development of artificial intelligence in health, for instance, the personalised healthcare apps for diagnoses and medicines management**.** The three major areas of medical advancement in AI are Diagnostics, Engagement, and Digitization[139]. The use of Artificial Intelligence is already allowing a test that analyses cancer tumours within 24 hours and can predict the best candidate drugs for personalised treatments.[140] The use of AI to map over 200 million proteins can assist in identifying sex related differences[141] in protein expression and improve the development of treatments. This can replace the existing time-consuming and costly methods such as X-ray crystallography and cryo-electron microscopy to solve protein structures[142]. AI is also at the core of robotic surgery, remote diagnosis, and X-ray analysis. It can also play a pivotal role in identifying and eliminating sex, gender, and other bias in scholastic, course, and research online and offline medical education publications and materials.

3D Printing

3D printing of tablets has been successfully achieved[143]. Scientists at the University College London (UCL) have fabricated 3D-printed tablets loaded with paracetamol within 17 seconds. By tweaking the composition of the resin the team could also fine-tune the drug release rates of the tablets. Because the process can be tailored the possibility of providing individualised medication becomes practical. This has the potential to radically reduce the occurrences of ADE, especially in women, as formulations are individually specific and can take account of sex, age, race, genome, medications in use, and other variables that impact medication appropriateness and efficacity.

Mobile and wearable technologies

The diagnostic and monitoring opportunities of mobile and wearable devices are being explored because of the improvements in device sensors, standards, and advances in remote or on-device diagnostic AI[144]. These can have a role in monitoring cardiac conditions, circulatory efficiency, oxygen levels, mobility, and temperature all of which are of special importance to post menopausal women.

The Downside of Technology

However, caution is needed concerning technology and medicine. As most of the emerging technologies are data-dependent it is necessary to ensure that they are not populated with data that is out of date, biased, or inappropriate for their purpose. Where this is not done their use will be suboptimal and potentially fatal to patients. Key to this is the management of data quality and ensuring the algorithms used are fit for purpose, and the subject of the most rigorous compliance to national and international standards. In 2021 the EU proposed new legislation[145] for the governance of Artificial Intelligence and algorithms. Any such legislation must ensure the use of AI and algorithms in medicine is rigorously controlled and has a tight comprehensive and enforceable governance, reporting, and review regime. Data science expertise will be a critical skill for future medical practitioners. Ensuring that women entering the medical profession are as equipped to practice in a data-rich environment is critical to preventing a new sex and gender gap in medicine.

The Death of Medical Discrimination?

A key societal question is " Can sex and gender and other discriminations be eliminated? ". At its core bias elimination requires societal changes in thoughts, words, and actions. From past evidence and ongoing campaigns to control and prevent misinformation, the answer is less than positive. Some successes have been achieved where efforts to do so have been long-term, consistent, and have explicitly proven positive benefits.

Bias: Pride in prejudice?

Sex and gender discrimination in medicine is a good example of implicit and explicit bias. The first documented sex and or gender-specific bias was recorded in Egypt in 1900 BC (Kahun Papyrus)[146]. The history of hysteria[147] is interesting in its demonstration of the persistence and constant tailoring of hysteria by societies to reflect and defend their sex and gender norms, biases, and accepted treatment of women. Its present manifestations are maintained by the closed nature of hierarchies and associations, imbalances in power, sex and gender-blind processes/procedures, sex and gender disadvantageous work environments, and a pervasive attribution of a lower status of female practitioners and patients.

Everyone has biases. Individuals generally have one or more biases. These can be a mix of explicit and implicit biases. The word intersectionality is used to describe situations where more than one bias is active at the same time (eg: obese + woman + race). Should an individual have 8 biases there are over 40,000 combinations of biases possible. Such intersectionality makes it difficult to identify and address the primary and secondary bias that is being acted upon. Bias can transfer between individuals, organisations, and generations[148]. The two main mechanisms are absorption (exposure and observation leading to internalisation) and imposition (required adoption for acceptance). Individuals experience both during their personal and professional lives. In organisations, their "culture" formally or informally codifies, dictates, and socialises individuals in the traditions, norms, hierarchy, processes, procedures, behaviours, and biases that they are required/expected to adhere to. Failure to do so risks sanctions such as isolation, lack of advancement, reduced status, loss of benefits, or expulsion.

The same is true of the medical field. Where the socialisation process is rigid and closed, evidence-based change can be difficult or non-existent.

Intervention points

There are key potential areas of intervention to reduce or eliminate bias. The elimination of bias in educational materials and teaching mechanisms offers an early opportunity to provide bias-free content and project the techniques for managing bias manifestations in personal or group interactions.

However, the elimination of bias from content is problematic. In the world today everyone is a creator and consumer of content. Biased material flows freely between individual actors without intervention except in cases of extreme bias such as hate language. The difficulties in managing such content flows are starkly illustrated by the ineffectual efforts to deal with misinformation on the Internet. The lack of political will and obscure internal corporate policies are major reasons for the issues today with the socially appropriate creation, storage, transfer, and responsibility for the availability and impact of misinformation. However, new content created or sourced for use inside or by the medical profession can be closely monitored and rigorously prevented from representing a biased view or position.

Existing content poses a problem in that it remains in circulation and any biases within it are accessible and influential to new audiences. Most of this content, even if in hard copy, now usually has a digital master that is used for reproduction. As such it is an ideal candidate for the use of rules-based Artificial Intelligence (AI) tools to parse it and identify actual or potentially biased material for correction and republication. The same approach can be applied to medical research publications where all articles are checked for bias before being accepted for publication. Initial simple rules could be used such as neutralisation, except where sex and or gender appropriate, are used to remove sex and gender pronouns or the identification of sex and or gender-inappropriate graphics in texts.

As seen earlier organisations have cultures, policies, norms, and sanctions for most activities. However, when looking at sex and gender few organisations have explicit and comprehensive policies that cover the life stages of women. Such policies must cover menstruation, maternity (pre/during/postpartum), reintegration to work, childlessness, and menopause. Without these management tools, implicit or explicit sex and or gender bias cannot be addressed in the medical profession or any other organisation. In addition, the rigour and sensitivity with which sex and or gender policies are applied are often negligent and ineffective.

From all the evidence the general elimination of sex and gender and other bias is unlikely using the fragmented and ineffective mechanisms today. What is possible is targeted action on high-impact areas such as education, organisational policies, selection and review processes, and promotion processes. Essential to the success of such interventions is firm, long-term political and management commitment at all levels of society.

Conclusions

In 2019 the total annual EU direct and indirect medical costs were over € 4.76 trillion. This represents the 9.9% of EU GDP that is spent on health plus 2.4 times that from lost earnings and reduced productivity.

The total cost is close to 30% of the EU GDP per annum.

The journey towards sex and gender equality in medicine requires a multifaceted approach that involves stakeholders at all levels. By acknowledging and addressing the complex factors that contribute to sex and gender inequality, we can create a more inclusive, diverse, and equitable healthcare system that benefits all patients and supports the professional growth and development of medical professionals, regardless of their sex and gender. Below, are some approaches by topic.

Addressing Systemic Barriers

- Identify, quantify, and address systemic barriers that contribute to sex and gender inequality in medicine, such as sex and gender pay gaps, unequal access to career advancement opportunities, and biased recruitment and promotion practices.
- Increase advocacy for policy and strategy changes at EU, national, and institutional levels to address structural inequalities and create a more level playing field for women in medicine and associated disciplines.
- Drive greater collaboration between medical organizations, educational institutions, and policymakers to create a common approach to promoting sex and gender equality in medicine.
- Drive the inclusion of women in leadership roles within medical organizations, committees, and boards to promote diverse perspectives and influence decision-making processes.
- Mandate, develop, rigorously enforce and require transparency on policies focused on creating a culture of respect, inclusivity, and diversity within medical institutions.
- Require transparent and equitable evaluation and promotion systems to ensure that women are fairly assessed and rewarded for their contributions to the medical profession.
- Drive mentorship and networking opportunities for women in medicine to support career growth and representation in leadership roles.
- Require medical organizations to be transparent about their sex and gender equality policies, practices, and outcomes, and to share their successes and challenges with the broader medical community.
- Regularly monitor and report on the impact of sex and gender equality initiatives, and use this data to inform decision-making and guide future efforts.

Promoting Sex and Gender Diversity in STEM and Medical Education

- Use media platforms, public fora, and conferences to raise awareness of sex and gender inequality in STEM and medicine and to promote public discourse on the topic.
- Require educational institutions to promote early exposure to STEM fields and create opportunities for young girls to explore their interests in science and medicine.
- Drive diversity and equality in STEM and medical education by eliminating biases in educational and support materials and promoting equal opportunities for women.

- Encourage and support girls and young women to pursue STEM and medical careers by providing mentorship, scholarships, and resources.
- Integrate sex and gender studies and diversity-focused courses in medical curricula to equip future healthcare professionals with the knowledge and skills to provide equitable care to all patients.
- Require career long sex and gender sensitivity training and education programs for medical professionals, students, and staff to increase awareness of existing and emerging sex and gender biases and disparities in healthcare.

Targeted Recruitment and Retention Strategies

- Implement targeted recruitment and retention strategies to attract and retain women in medicine, particularly in underrepresented specialties.
- Offer incentives, such as financial support, flexible work options, and mentorship opportunities, to encourage women to enter and remain in the medical profession.
- Foster a welcoming and inclusive work environment that values the unique perspectives and experiences of women, and actively addresses existing and emerging barriers to their success.
- Mandate and rigorously enforce reporting on zero-tolerance policies regarding physical and/or psychological sex and gender harassment, violence, and discrimination.
- Implement family-friendly policies in medical institutions to support women in balancing their personal and professional lives.
- Promote flexible working arrangements, such as part-time or remote work options, to enable women to pursue careers in medicine without compromising their personal responsibilities, career progression, and post career well-being and quality of life.

Recognizing and Addressing Intersectional Bias and Discrimination

- Recognize and address the multiple forms of discrimination experienced by implementing inclusive policies that consider race, ethnicity, religion, sexual orientation, and other intersecting factors in addition to sex and gender.
- Implement anti-discrimination policies and procedures in medical institutions to prevent and address incidents of bias and harassment.
- Require the establishment of support systems, such as peer groups or counselling services, to assist those who have experienced discrimination or harassment.
- Drive a cultural shift in the medical profession to value and respect the importance of work-life balance for all medical professionals, regardless of their sex and gender.
- Collaborate with educational institutions to reform medical curricula and teaching practices, ensuring that they are sex and gender-sensitive and inclusive.
- Provide regular training and workshops for medical professionals to raise awareness of unconscious biases, stereotypes, and discriminatory behaviours.
- Require training and education for healthcare professionals to understand and address intersectional biases and their impact on patient care.
- Promote sex and gender-sensitive medical research and treatment guidelines to ensure that healthcare professionals are equipped to provide equitable and appropriate care to all patients.

Encouraging Collaboration and Advocacy

- Encourage experienced medical professionals to mentor and sponsor women in the early stages of their careers to foster growth, development, and representation in the field.
- Promote medical organizations as a strategic way to advocate for sex and gender equality by setting and enforcing standards for inclusivity and diversity.
- Establish clear reporting and accountability mechanisms to address discrimination, harassment, and bias in the medical profession.
- Develop mentorship programs that provide guidance, support, and resources for women pursuing careers in medicine, with a special focus on underrepresented specialties.
- Facilitate and incentivise networking opportunities for women in medicine to connect with peers, mentors, and sponsors who can provide career advice, support, and advocacy.
- Require resources and training for male medical professionals to better understand sex and gender inequality issues and learn how to be effective allies in addressing them.
- Encourage men in the medical profession to become more involved in the fight for sex and gender equality by recognizing their key role in the issue and promoting change and challenging discriminatory norms.
- Encourage male medical professionals to speak up and take action against sex and gender discrimination when they witness or become aware of it.
- Partner with NGOs, advocacy groups, and other stakeholders to support initiatives that address sex and gender inequality and improve healthcare access and quality for women.
- Share resources, knowledge, and best practices to build a collective understanding of the challenges faced by women in medicine and develop effective strategies to overcome them.

Promoting a Holistic Approach to Healthcare

- Encourage a holistic approach to healthcare that considers the unique needs, experiences, and circumstances of patients irrespective of their sex or gender.
- Promote research that focuses on understanding and addressing sex and gender differences in healthcare outcomes, treatment options, and disease prevalence.
- Collect and analyse disaggregated data to identify patterns, trends, and areas where anti-discrimination progress is being made or where further action is required.
- Train medical professionals to provide sex and gender-sensitive care that considers the social, emotional, and cultural factors that impact a patient's health.
- Require sex and gender appropriate approaches in existing and future medical curricula, policies, and clinical practices to create a more inclusive and equitable healthcare system.
- Establish key performance indicators (KPIs) and targets to measure progress in promoting sex and gender equality in medicine.
- Ensure that women are adequately represented in clinical trials and medical research to develop a more comprehensive understanding of sex and gender-specific health issues.
- Regularly review and update policies, procedures, and practices to ensure they remain relevant and effective in addressing sex and gender inequality in medicine.
- Require and publish the results of regular assessments and evaluations of the effectiveness of policies and initiatives aimed at addressing sex and gender inequality in medicine.

- Encourage and facilitate open dialogue and feedback among medical professionals to identify areas for improvement and create an environment of continuous learning and growth.
- Recognize and communicate the achievements and progress made in promoting sex and gender equality in medicine at an institutional level to maintain momentum and inspire further action.
- Require the sharing of findings and best practices with medical organizations, educational institutions, and policymakers to continually refine and improve efforts in promoting sex and gender equality.

Key takeaways

1) Women continue to be systematically discriminated against in all aspects of the medical profession and practice.
2) Sex and gender differences significantly impact the types, causes, and outcomes of medical interventions for both men and women.
3) Medical conditions specific to women receive less research consideration and funding than male or sex / gender-neutral conditions.
4) The medical profession, from theory to outcomes, fails to systematically capture and report sex and gender disaggregated data.
5) Women form the majority of medical students and graduates but a few hold decision-making positions in their career.
6) Medical training materials, courses, and Journals fail to provide sex and gender-appropriate information to students and practitioners. Models, content, and Illustrations are significantly and inappropriately male-biased.
7) Explicit and implicit biases against women change throughout their medical careers. Such biases are mainly exercised by medical colleagues, managers, and patients.
8) Women are underrepresented at all senior management levels in medical education, organizations, facilities, and editorial entities. This severely undermines their ability to progress in their careers and influences the medical profession and its evolution.
9) The impact of the female life stages is generally ignored by administrations and businesses. Few have policies related to mensuration, pregnancy, motherhood, perimenopause, and menopause. All of these life stages cause implicit or explicit discrimination against women in employment, earnings, reviews/career progression, re-entry to employment, retirement, and pensions.

By adopting a comprehensive and collaborative approach to addressing sex and gender inequality in medicine, we can create a more inclusive and equitable healthcare system that serves the needs of all patients and supports the professional growth of medical professionals, regardless of their sex and gender. By working together, we can ensure that the medical profession reflects the diversity of the communities it serves and provides high-quality, equitable care for everybody.

Policy Proposals

1) Create a specific Women's Healthcare Strategy for Europe.

2) Require business or institutional funding proposals for medical research and development to provide comprehensive publicly available disaggregated results data on gender, sex and age in order to be eligible for EU or national funding.

3) Require the provision of comprehensive disaggregated results data on gender, sex and age in the approval process of all medical products, processes, procedures, techniques, or devices for sale and use in the EU.

4) Increased and targeted EU funding is made available for research into female-specific medical, social, and employment issues.

5) Include specific policies in EU and national legislation requiring businesses and institutions to facilitate, action, and be accountable for the positive mediation of employment issues arising from the female stage of life conditions such as menstruation, pregnancy or menopause.

6) Set minimum levels of female members of editorial boards for medicine-related online and offline journals, publications, courses, and books.

7) Examine, edit and update all medical teaching materials, courses, and review processes to eliminate sex, gender, and other biases.

8) Include specific provisions in EU and national legislation on Artificial Intelligence requiring the identification, prevention, and elimination of sex, gender and other biases in the models, logic, and operation of systems in medicine and related fields.

9) Enhance measures across the EU to positively influence and incentivise girls and women to enter STEM education and careers, with a specific emphasis on data sciences.

10) Cap childcare costs and index them to wage growth to maintain comparative affordability and ensure all childcare costs are 100% tax deductible.

11) Amend EU and national legislation to provide more comprehensive, stronger, and enforceable protection against interpersonal violence, especially in domestic and medical environments.

Word Index

Appendix 1: Costs: Societal and Personal

Variable	Data
Average weeks worked in the EU	37
Average hourly labour cost in the EU euro (male)	29
Average hourly labour cost in the EU euro (-13% for women)	25
Total EU Female Real Million	263
0 - 14 EU Female %	15
0 - 14 EU Female Real Million	39
15 - 24 EU Female %	10
15 - 24 EU Female Real Million	27
25 - 54 EU Female %	41
25 - 54 EU Female Real Million	106
55 - 64 EU Female %	13
55 - 64 EU Female Real Million	34
65+ EU Female %	21
65+ EU Female Real Million	56
Pre Puberty 0 - 14 EU Female %	15
Pre Puberty 0 - 14 EU Female Real Million	39
Fertile 15 -54 EU Female %	51
Fertile 15 -54 EU Female Million	134
Post Menopause 55+ EU Female %	34
Post Menopause 55+ EU Female Real Million	90
Female Labour Participation EU workforce that is female %	46
Female Labour Participation EU Fertile 15 - 64 %	68
Female Labour Participation EU Fertile 15 - 64 Real Million	114
Female Labour Participation EU Post Menopause 65+ %	60
Female Labour Participation EU Post Menopause 65+ Real Million	34
Cost of doctor training Euro (UK Figure)	186000
Cost of a Nurses qualification Euro (UK Figure)	44000
Cost of a non-UK Nurses recruitment/onboarding Euro (UK Figure)	13000
Menstruating women 15 -54 million	134
Menstruating women 15 -54 with issues million	13
Menstruating % women labour force 15 -54 with issues %	10
Menstruating women 15 -54 labour force with issues EU 27 Million	9
Menstruation average weekly hours pay lost to absenteeism and presentism	160
Menstruation average weekly hours lost to absenteeism and presentism	6
Menstruation average annual productivity days lost to absenteeism and presentism	9
Menstruation average annual labour cost lost to absenteeism/presentism Euro Billion	54

Endometriosis's Annual cost to the EU 27 Euro Billion	252
Symptomatic Endometriosis suffers millions	29
Swedish Endometriosis direct medical cost/case Euro	4282
Swedish Endometriosis indirect cost/case Euro	4486
Endometriosis % of sufferers Absence/presenteeism	68
Swedish Endometriosis work reduction %	36
Swedish Endometriosis work absence %	32
Average work hours lost per week due to endometriosis	7.2
Endometriosis Labour cost per annum EU 27 Euro Billion	129
Menopause lost labour costs per annum Euro billion	17
Average work hours lost per annum per Peri-menopause / menopause female	12
Female Labour Participation EU Post Menopause 65+ %	60
Female Labour Participation EU Post Menopause 65+ Real Million	34
Adverse Drug Events Annual cost EU Euro billion	79
Adverse Drug Events Annual cost Females EU Euro billion	52
Adverse Drug Events Annual Deaths	197000
Adverse Drug Events Annual Deaths female	130000
Migraine treatment per annum EU Euro	49.3
Migraine sufferers female during lifetime million	113
Migraine sufferers' female annual loss per sufferer Euro	436
Migraine EU annual losses treatment, productivity and personal losses Euro billion	158
Pain treatment cost EU 27 Euro billion	63
Pain treatment cost per person per annum EU 27	142
Pain productivity cost losses female workforce EU 27 Euro billion	9.1
Pain treatment costs females EU 27 Euro billion	32
Sex and gender based Interpersonal violence (IPV) annual cost EU Euro billions	336
Sex and gender based IPV against females annual cost EU Euro billions	278
Sex and gender based IPV against females average annual cost all EU women Euro	1000
Estimated mental health sufferers in the EU is 27 million	84
Estimated annual cost of mental health treatment in the EU 27 Euro Billion	600
% of mental illness beginning up to the age of 14	50
% of mental illness beginning up to the age of 24	75
% of Depressive disorders due to parental domestic violence (PDV)	23
% of women with Pandemic disimproved mental health	83
% GDP loss of productivity and health and social care expenses EU 27	4

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