
بسم الله الرحمن الرحیم
Tabriz
University
of Medical
Sciences

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- M.H.SOMI .MD

Social Determinants of Health



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Healthy People 2030

What is Precision Public Health (PPH)?



- **Definition:** Tailoring public health interventions using genetic, environmental, and behavioral data.
- **Goal:** *"Deliver the right intervention to the right population at the right time.«*
- **Key Drivers:** Genomics, AI, exposome research, and equity-focused implementation.

Core Components of PPH

- **Human Genomics:** Polygenic risk scores, population screening (e.g., CDC Tier 1 applications).
- **Pathogen Genomics:** Outbreak tracking (e.g., COVID-19 variants, wastewater surveillance).
- **Social/Environmental Data:** Exposome analysis, geospatial health disparities.
- **AI & Big Data:** Predictive modeling (e.g., SENTINEL for outbreak detection).

Human Genomics in Action

- **Examples:**
  - Newborn screening for hereditary cancers (Lynch syndrome, BRCA).
  - Polygenic risk scores for breast cancer (e.g., BOADICEA model).
- **Challenges:** Eurocentric bias in genomic databases, equity gaps in testing access.

Pathogen Genomics & Global Surveillance

- **COVID-19:** Variant tracking (Delta, Omicron) informed public health policies.

- **Innovations:**
  - Africa Pathogen Genomics Initiative (30+ countries with sequencing capacity).
  - Wastewater surveillance for community-level pathogen detection.

Social & Environmental Integration

- **xposome:** Air pollution, green spaces, and walkability linked to cardiovascular/depression risks.

- **Digital Tools:** Machine learning for real-time exposure monitoring and intervention tuning.

AI's Role in PPH

- **Applications:**
  - **SENTINEL:** AI-driven Twitter analysis for outbreak prediction.
  - **BRIDGE Trial:** Chatbots for genetic testing eligibility.

- **Risks:** Algorithmic bias, lack of diverse training data.

Challenges & Equity Gaps

- **Data Bias:** Underrepresentation of non-European populations in genomics.
- **Implementation Barriers:** Structural racism, low genomic literacy among providers.
- **Ethics:** Privacy concerns (e.g., life insurance discrimination).

Future Directions

- **Equity-Focused Implementation:** Antiracism frameworks for PPH interventions.
- **Workforce Training:** Genomics competencies for public health professionals.
- **Global Collaboration:** Networks like WHO’s International Pathogen Surveillance Network.

Conclusion & Call to Action

- **PPH = Precision + Equity.**
- **Key Needs:**
  - Diverse genomic databases.
  - Robust AI validation.
  - Policy alignment with technological advances.

Quote: ***"PPH must bridge the gap between innovation and equitable implementation."***

Gut Health

- **Definition:** "Gut health" refers to optimal GI function, including digestion, microbiota balance, immunity, and well-being.
- **Popularity:** Increasingly discussed in medicine and food industries.
- **Challenge:** Lack of clear scientific definition and measurement tools.

Key Criteria for Gut Health

- Effective digestion and absorption.
- Absence of GI illness.
- Normal/stable intestinal microbiota.
- Effective immune status.
- Well-being (physical and mental).

- ***"Gut health is more than the absence of disease."***

The GI Barrier & Microbiota

- **GI Barrier:** Complex system of epithelial cells, immune defenses, and the enteric nervous system (ENS).

- **Microbiota:** ~10^{14} bacteria in the colon; critical for:
  - Pathogen defense.
  - Nutrient metabolism.
  - Immune regulation.

Mechanisms Linking Gut Health to Disease

- **Dysbiosis** (microbiota imbalance) → Increased permeability ("leaky gut") → Inflammation.

- **Associated Diseases:**
  - *GI:* IBS, IBD, infections.
  - *Extraintestinal:* Allergies, obesity, autoimmune disorders.
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How to Assess Gut Health?

- **Subjective Tools:** Questionnaires (e.g., IBS-QOL, IBDQ).

- **Objective Measures:**
  - Permeability tests (lactulose/mannitol).
  - Microbiome analysis (metagenomics).
  - Immune markers (IgA, cytokines).

Maintaining Gut Health

- **Lifestyle:** Balanced diet (high fiber, low processed foods), exercise, stress management.
- **Avoid:** Antibiotic overuse, NSAIDs, smoking.
- **Interventions:** Probiotics (e.g., *E. coli* Nissle 1917), prebiotics.

Probiotics and Gut Health

- **Evidence:** Reduce antibiotic-associated diarrhea, IBS symptoms, and inflammation.
- **Mechanism:** Strengthen tight junctions, modulate immune responses.

*"**Probiotics may restore microbial balance and barrier function.**"*

Future Directions

- **personalized Medicine:** Tailoring diets based on microbiome profiles.
- **Research Needs:**
  - Standardized gut health biomarkers.
  - Long-term probiotic studies.
- **Goal:** Integrate gut health into preventive healthcare.

Conclusion

- Gut health is a multifaceted concept linked to overall well-being.
- Key pillars: Microbiota diversity, barrier integrity, and immune balance.
- **Call to Action:** Prioritize gut health in clinical practice and public health.

"A healthy gut is the foundation of a healthy body."

Global Burden of Five Major Gastrointestinal Cancers

- **5 million** new GI cancer cases annually (2020).
- **3.5 million** deaths; **1 in 3** cancer deaths globally.
- Top cancers: Colorectal (1.9M cases), gastric (1.09M), liver (830K deaths).
- **High incidence**: Developed regions (e.g., North America, Europe).
- **High mortality**: Developing regions (Asia, Africa).
- Disparities due to risk factors (e.g., HBV, *H. pylori*) and healthcare access.

- **Global Burden of Five Major Gastrointestinal Cancers**
- Review by Arjun Singh, *Gastroenterology Rev* 2024

Colorectal Cancer (CRC)

- **3rd most common** cancer globally.
- Declining in high-income countries (screening); rising in transitioning economies (Westernized diets).

Screening: Colonoscopy reduces mortality by 27–60%.

Gastric & Liver Cancers

- **Gastric**: Linked to *H. pylori*, salted foods. Declining globally except in Eastern Asia.

- **Liver**: **3rd leading cause** of cancer deaths. Driven by HBV/HCV, aflatoxins, alcohol. HBV vaccination prevents 90% of HCC in endemic areas.

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Oesophageal & Pancreatic Cancers

- **esophageal**: Squamous cell (tobacco/alcohol) vs. adenocarcinoma (obesity/GERD).

- **Pancreatic**: **7th deadliest**; rising with obesity/diabetes. **5-year survival: <10%**.

Prevention Strategies

- **vaccination**: HBV to prevent liver cancer.
- **Screening**: Colonoscopy (CRC), endoscopy (gastric).
- **Lifestyle**: Reduce smoking, alcohol, processed foods.

Future Directions

- **Research**: Vaccines (e.g., *H. pylori*), early detection tools (e.g., IoT-enabled screening).
- **Global action**: Equitable healthcare access, policy changes, public awareness.
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Role of GI Endoscopy in Screening Digestive Tract Cancers in Euro

- **1 in 3** cancer-related deaths in Europe caused by GI cancers.
- **600,000** new GI cancer cases annually in the EU.
- **5-year survival**: 48% (colorectal), 24% (gastric), 12% (esophageal), 6% (pancreatic).
- Endoscopy enables early detection of precancerous lesions, improving survival

Colorectal Cancer (CRC) Screening

- **Recommended for**: Average-risk adults aged 50–75 years.
- **Primary method**: Fecal immunochemical test (FIT).
- **Alternatives**: Colonoscopy (gold standard) or sigmoidoscopy.
- **Benefits**: 21–69% reduction in CRC incidence/mortality.
- **Challenges**: Low participation rates in Europe (<25%).

Gastric Cancer Screening

- **Recommended for**: High-risk regions (age-standardized rate ≥20/100,000).
- **Target group**: Adults ≥40 years.
- **Method**: Upper GI endoscopy (every 1–5 years).
- **Cost-effective** in Asia; limited evidence in Europe.
- **Precursor**: *H. pylori* infection, intestinal metaplasia.

Esophageal Cancer Screening



- **Squamous Cell Carcinoma (SCC)**:
  - **High-risk groups**: Head/neck cancer, achalasia, caustic injury.
  - **Not recommended** for general population.
- **Adenocarcinoma (EAC)**:
  - **High-risk groups**: Chronic GERD (>5 years), obesity, male, age ≥50.
  - **Tools**: Endoscopy or Cytosponge (TFF3 biomarker).

Pancreatic Cancer Screening

- **Recommended for**: High-risk individuals (lifetime risk >5%).
  - Genetic mutations (e.g., BRCA2, CDKN2A).
  - Strong family history.
- **Method**: Endoscopic ultrasound (EUS) + MRI/MRCP.
- **Challenges**: Low yield, high cost, risk of overtreatment.

Cost-Effectiveness

- **CRC screening**: Cost-saving due to reduced treatment costs.
- **Gastric cancer**: Cost-effective only in high-risk regions.
- **Esophageal/pancreatic**: Limited to high-risk groups.
- **Barriers**: Endoscopy capacity, adherence, healthcare infrastructure.
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Challenges & Future Directions

- **Low participation**: Public awareness, organized programs needed.
- **Resource limitations**: Endoscopy capacity, trained personnel.
- **Emerging tools**: Non-endoscopic methods (e.g., Cytosponge).
- **Research**: Biomarkers, genetic risk stratification.
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Reducing the Global Cancer Burden with GI Screening: China's 30-Year Practice

- **Esophageal Cancer (EC) Screening**
- **High-Risk Regions**: Henan, Hebei, Shanxi.
- **Methods**:
  - **Endoscopy with iodine staining** (gold standard).
  - **Balloon/sponge cytology** in rural areas.
- **Impact**:
  - **29–66% reduction in incidence/mortality in cohorts.**
- **Challenge**: No RCT evidence; reliance on high-risk targeting.

- **Gastric Cancer (GC) Screening**
- **High-Risk Areas**: Linqu, Zhuanghe, Wuwei.
- **Methods**:
  - **Serum biomarkers** (*H. pylori*, pepsinogens).
  - **Endoscopy** for high-risk individuals.
- **Impact**:
  - **61–64% mortality reduction** for non-cardia GC.
  - **46% lower incidence** with *H. pylori* eradication.
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- **Colorectal Cancer (CRC) Screening**
- **Rising Trend**: +2.4% annual incidence (males).
- **Methods**:
  - **FIT (fecal immunochemical test)** + colonoscopy.
  - **Questionnaires** for risk stratification.
- **Challenges**:
  - Low uptake (25% urban, 59% rural).
  - No nationwide program; limited mortality data.

- **Innovations & Future Directions**
- **AI & Liquid Biopsy**: Early research stage; not yet scalable.
- **Non-Invasive Tools**: e.g., FIT-DNA (cost-prohibitive).
- **Precision Screening**:
  - **Two-step models** for ESCC (risk prediction + endoscopy).
  - **Serum panels** for GC (*H. pylori* biomarkers).

- **Policy Recommendations**
- **Expand Coverage**: Target high-risk regions/populations.
- **Improve Quality**: Train endoscopists; standardize protocols.
- **Increase Awareness**: Public campaigns to boost participation.
- **Data Sharing**: Strengthen national cancer registries.
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Functional Gastrointestinal Disorders (FGIDs) as a Public Health Problem

- **Overview of FGIDs**
- **Definition:** Heterogeneous chronic conditions without structural/biochemical explanations (e.g., IBS, functional dyspepsia).
- **Public Health Relevance:**
  - High prevalence (10–15% globally).
  - Significant disability and economic burden.
- **Key Challenge:** Lack of clear biomarkers; symptoms overlap.

- Classification (Rome III Criteria)
- Major FGID Categories:
- Esophageal (e.g., functional heartburn)
- Gastroduodenal (e.g., functional dyspepsia)
- Bowel (e.g., IBS, functional constipation)
- Abdominal Pain & Biliary Disorders
- Anorectal (e.g., fecal incontinence)

- **Prevalence:**
  - IBS: 3–20% (USA); similar in developed/developing nations.
  - 42% of Olmsted County, MN, reported ≥1 FGID over 12 years.
- **Natural History:** Symptoms fluctuate; overlap between FGIDs is common.
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- **Healthcare Burden**
- **High Utilization:**
  - IBS ranks 6th in U.S. outpatient GI diagnoses.
  - Only 25% consult doctors, but costs are substantial.
- **Economic Impact:**
  - Direct costs: Up to $8,750/patient/year (2002).
  - Indirect costs (e.g., work absenteeism): $20.2 billion (2000).

- **Comorbidities**
- **Psychiatric:** Depression, anxiety (linked but not universal).
- **Extraintestinal:**
  - Chronic fatigue (51%), pelvic pain (50%), TMJ disorders (64%).
- **Somatization:** Explains only a subset of cases.

- **Mortality Risks**
- **Traditional View:** No increased mortality.
- **Emerging Concerns:**
  - Unnecessary surgeries (e.g., cholecystectomy) carry risks.
  - Chronic constipation linked to higher mortality (marker of other diseases?).

- **Conclusion**
- FGIDs are a major public health challenge due to prevalence, disability, and costs.
- Research priorities: Biomarkers, prevention, and patient-centered care.

Quote: ***"Interventions at the population level could provide significant benefits."***

Inflammatory Bowel Disease (IBD) – A Public Health Problem

- **Definition:** Chronic inflammatory disorders (ulcerative colitis [UC] and Crohn's disease [CD]) with unknown etiology.
- **Public Health Relevance:**
  - High morbidity, severe complications (e.g., toxic megacolon), early disability.
  - Significant economic burden due to lifelong treatment/surveillance.
- **Key Challenge:** Dynamic disease progression; varies by age, location, and behavior.
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- **Incidence:**
  - **IBD:** 1.89/10^5 inhabitants (UC: 1.54/10^5; CD: 0.35/10^5).
  - Lower than Northern Europe (e.g., Norway: UC 13.6/10^5).
- **Demographics:**
  - 65% of cases onset before age 50.
  - Peak incidence: 35–39 years.
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- **Risk Factors & Genetic Susceptibility**
- **Environmental Factors:**
  - **UC:** More frequent in nonsmokers (62.7%) and those without appendectomy.
  - **CD:** Linked to smoking (37.3%).
- **Genetic Markers:**
  - Family history in 2.4% of cases (maternal lineage: 47%).
  - pANCA positive in 11% of UC patients (not in CD).

- **Disease Severity & Complications**
- **Severe Attacks:**
  - 21% at onset; 41% during disease progression.
  - Toxic megacolon in 2.4% of patients.
- **Cancer Risk:**
  - Dysplasia in 4.4% of patients (premalignant lesions).
  - Colorectal cancer risk: 2% at 10 years, 18% at 30 years.

- **Quality of Life & Socioeconomic Impact**
- **Patient Burden:**
  - Chronic symptoms limit work, education, and social life.
  - High rates of job loss and dietary restrictions.
- **Economic Costs (Europe):**
  - **Diagnosis:** UC €2,640; CD €3,524.
  - **Maintenance:** €305–1,185/year.

- **Public Health Measures (France vs. Romania)**
- **France:** Comprehensive support (tax exemptions, disability benefits, home care).
- **Romania:** Limited to free hospitalization (Law 95/2006).
- **Call to Action:** Advocate for inclusion in National Health Programs.

- **Surveillance & Prevention Strategies**
- **Clinical Monitoring:**
  - Regular colonoscopy for dysplasia/CRC detection.
- **Prophylactic Surgery:**
  - Proctocolectomy for high-risk UC patients.
- **Behavioral Interventions:**
  - Smoking cessation for CD; potential nicotine therapy for UC.
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- **Future Directions**
- **Genetic Research:** Identify high-risk populations.
- **Policy Development:** Expand social protections in LMICs.
- **Awareness Campaigns:** Educate on early symptoms and risk factors.
- IBD remains a major public health challenge due to its chronicity, complications, and costs.

- **Key Message:** ***"Early detection, multidisciplinary care, and policy support are critical to reducing IBD's burden."***

- **Future Directions**
- **Biomarkers:** Proteomics, gut microbiota, inflammation (e.g., duodenal eosinophilia).
- **Prevention:** Post-infectious IBS (antibiotics?).
- **Severity Stratification:** Need validated tools for treatment decisions.
- **Public Awareness:** Demystify FGIDs to reduce stigma.
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- **Impact on Quality of Life**
- **Patients:**
  - Impaired QoL comparable to IBD or peptic ulcers.
  - Social isolation, fear of symptoms, stigma.
- **Families:** Disrupted lives due to caregiving.
- **Workplace:** 21% reduced productivity (U.S. survey).


با تشکر از توجه شما