Health Impacts from Climate Change & Zoonotic Spillover:

A Geospatial Model for Surveillance and Action
Agenda

1. HSR.health mission and methods
2. Climate change and zoonotic spillover phenomenon explained
3. Detection of high-risk areas
4. Methodology
5. Our Solution -
6. Conclusion
A zoonosis is an infectious disease that has jumped from non-human animals to humans.[1]

- More than 6 out of every 10 known infectious diseases have zoonotic origins.[2]
- 3 out of every 4 new or emerging infectious diseases in humans come from animals.[2]
Zoonotic Spillover

**SPILLOVER FORCE OF INFECTION**

- Stuttering transmission among humans: $R_0 < 1$
- Sustained transmission & human outbreaks: $R_0 > 1$

**Reservoir Dynamics**
- Enzootic or Epizootic

Spillover transmission among species
▪ Perform digital disease surveillance on a global basis.
▪ Identify early signals of potential human-to-human transmission.
▪ Enable effective allocation of resources to combat health disasters.
▪ Guide efforts to safely reopen economies and resume normal activities.
▪ Leverage insights from broad sets of social & environmental determinants of health.
▪ Enable Organizations to anticipate and take advantage of health risks.
▪ Assess the current and future health & medical needs of a population.
▪ Stratify patients for risk of adverse outcomes.

Hospitals
Health Departments
Community Service Organizations
Emergency Management
Insurers
Health Systems
Leverage Actionable Insights from Health, Social, & Environmental Data to:
Global Public Health
WHO
National CDCs
Hedge Funds
Airlines
Cruise Lines
Hotels
Real Estate
School Systems
Logistics

Climate Change: Global Impact

MELTING PERMAFROST EXPOSING ANCIENT VIRUSES

BIODIVERSITY LOSS

DEFORESTATION & HABITAT LOSS
Who

HSR.

Is and What We Do

▪ Perform digital disease surveillance on a global basis.
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Health Risk Data & Indices

CLIENT BENEFITS

SOLUTION

Hospitals
Health Departments
Community Service Organizations
Emergency Management Insurers
Health Systems

Leverage actionable insights from health, social, & environmental data to:

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Climate Change:

Global Impact

MELTING PERMAFROST EXPOSING ANCIENT VIRUSES

DEFORESTATION & HABITAT LOSS

LATIN AMERICA AND THE CARIBBEAN
94% BIODIVERSITY LOSS SINCE 1970

BIODIVERSITY LOSS

MELTING PERMAFROST EXPOSING ANCIENT VIRUSES

DEFORESTATION & HABITAT LOSS

Climate Change:

Global Impact
Zoonotic Spillover Disease Related Deaths

- **SARS-COV-1**: 774
- **MERS**: 858
- **EBOLA**: 11,325
- **HIV/AIDS**: 680,000 in 2020
- **INFLUENZA**: 12,000-52,000 per year
- **TUBERCULOSIS**: 1.5 mil in 2020
- **SARS-COV-2**: >5.2 mil as of 12/6/21
Existing Systems

SAGES
Suit for Automated Global Electronic bioSurveillance

MedShr
Share knowledge
Save lives

Open Data Kit

epiinfo™

KoBoToolbox

GoData

NSSP
National Syndromic Surveillance Program

CommCare

PODD

HSR.health+
Our Approach

- Ingest models of climate change and its environmental and habitat impacts
- Geospatial mapping of high risk areas for zoonotic spillover
- Collaborate with public health decision makers to react and respond to emerging disease threats
  - Target surveillance capabilities to areas of highest zoonotic spillover risk
Methods

Disease and Outbreak

Data Gathering

Cleaning, Preparation and Manipulation

Feature Extraction and Selection

Processed Data

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<th>SVI</th>
<th>EID events</th>
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Machine Learning

Risk of Zoonotic Spillover Events in Peru

Risk Score

- > 7-9
- > 5-7
- > 4-5
- > 2-4
- 1-2
“COVID-19 has forced us to think differently and leverage data in a more meaningful way,” says Kenneth T. Bellian, MD, MBA, Principal, Chief of Clinical Innovation, Jensen + Partners. “It has been paramount to determine the future demand for services and then have the ability to align the critical resources such as clinical space, staffing, and equipment like ventilators. Future forward applications like HSR.health’s Risk Indices are indispensable when aligning the supply of scarce resources with the pending demand for services.”
Call to Action: Proof of Concept

- Criteria for Candidate Regions/Countries:
  - High risk animal populations
  - Climate change susceptibility
  - History of emerging zoonotic disease
  - Overall health burden

- Location: Sub-Saharan Africa, Peru, India

- Disease: Viral Hemorrhagic Fever (Africa)

- Timeline: 12 weeks

- Collaboration between public health systems, medical systems, and data providers (EO, mobility data)
Benefits

- Preventing future pandemics and lowering local & global disease burden
- Developing faster & comprehensive techniques for disease surveillance
- Reduced economic impact of disease local & global
- Deployment of advanced technology
- Capacity building in GIS, AI, public health
- Opportunity for international collaboration
- Advancing the capacity of global public health
Global efforts to stem climate change are underway, yet planning for its potential impact remains urgent.

Zoonotic spillover events have the potential to lead to new global pandemics.

Current infrastructure and surveillance methods are built to respond after new emerging infectious diseases have already spread.

Our approach will make accurate predictions on where a potential spillover event is likely to occur to aid in proactive measures.
HSR. health

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Careers :
https://hsr.health/careers/

<table>
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<tr>
<th>Company</th>
<th>Description</th>
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<tr>
<td>esri</td>
<td>HSR.health leverages the broad, global reach of the Esri’s ArcGIS Marketplace to market its GeoAI solutions for public health.</td>
</tr>
<tr>
<td>xentity corporation</td>
<td>Xentity and HSR.health collaborate on designing enterprise ready solutions responsive to the needs of the emergency response and public health communities.</td>
</tr>
<tr>
<td>gideon</td>
<td>Data curation and technical collaboration to develop and communicate global infectious disease risks.</td>
</tr>
<tr>
<td>Open Geospatial Consortium</td>
<td>A close and historied partnership focusing on broad industry collaboration to leverage geospatial technologies in addressing global public health challenges.</td>
</tr>
<tr>
<td>Portals LLC</td>
<td>Portals LLC and HSR.health are proud to have responded to the shifting needs of governments in addressing COVID-19 response needs.</td>
</tr>
<tr>
<td>AWS</td>
<td>AWS provides promotional credits and technical cloud resources supporting the growth and expansion of our GeoAI suite of solutions.</td>
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<tr>
<td>Skymantics</td>
<td>Skymantics and HSR.health collaborate on the extraction of health risk information from EO data in real time.</td>
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• Human encroachment on natural habitats account for 30.6% of all zoonotic emergences³

• The annual deforestation rate between 2015-2020 was estimated at 10 million hectares⁴

• Optimal rates of spillover occur once 40% of the forest cover disappears⁵

• Our World In Data tracking of deforestation on a national scale⁷

• World Wildlife Fund’s 2020 Living Planet Report⁸

• Between 870-8,700 species will become extinct each year⁵,⁶

• Melting Permafrost releases unanticipated diseases⁹