How health informatics interventions can worsen inequality

By: Tiffany Veinot, MLS, PhD
Key Takeaways

• Health informatics interventions are at particular risk of fostering Intervention-Generated Inequalities (IGI)

• IGI can emerge at 5 stages of the intervention cycle

• Precautionary measures are necessary to guard against IGI emerging from informatics interventions
Intervention-Generated Inequality (IGI): when interventions disproportionately benefit advantaged groups.
IGI and Intervention Stages

- Baseline Health Inequality
- Inequality in Efficacy
- Inequality in Access
- Inequality in Uptake
- Inequality in Adherence
- Inequality in Effectiveness
Taking Action to Prevent IGI
STAGE 1: EFFICACY —
*Design of investigational interventions*
Stage 1: Efficacy

• Gender and informatics interventions for physical activity (PA)
  – PA interventions for older adults
    • Greater increase in PA for men than women
  – Pedometer + accelerometers + nurse visits, goal setting, PA diary
    • Stronger effects for men than women
  – Print vs web-delivered PA intervention – visualizations, education, tailored content
    • web version produced a decrease in PA days for women but not men.

(Elbert, Dijksta, Oenema, 2016; Haapala et al., 2009; Harris et al., 2015; Partridge et al., 2016; Peels et al., 2014; Springviolet et al., 2015)
Stage 1: Efficacy

How do differences arise?

• More able to advantage of & be supported by tech
• Gender
  – Gender roles - likelihood & level of use
• Socioeconomic status
  – Education, money, time (e.g., multiple jobs)
  – Networks with novel information and tech skills
• Neighborhood factors – local resources
• Racial inequities
  – Discrimination + cumulative effects of stressors
  – Differential treatment in medical contexts
  – Less likely to have a usual source of care
Stage 1: Efficacy
Precautions to avoid IGI

• Develop targeted interventions for health disparity populations
  – But pay attention to the diversity within the “vulnerable” group:
    • not monolithic and there are further within-group disparities (e.g., Black women living longer than Black men)
  – There is a need for more intersectional work
Stage 1: Efficacy

Precautions to avoid IGI

Socioeconomic and political context

Social hierarchy – processes of marginalization

Living and Working Conditions

Health System

Social and Community Networks

Individual Psychosocial Factors & Behavior

Upstream Determinants of Health

Downstream Disease & Disability
Stage 1: Efficacy

Precautions to avoid IGI

(Veinot et al., 2019)
STAGE 2: ACCESS —
Opportunities to use health informatics interventions
Stage 2: Access

• Non-adoption of patient portals associated with lack of broadband in zip code
  – 33% of rural Americans lack access to high-speed broadband internet to support video-based telehealth visits
• Telehealth usage post-COVID
  – People living in zip codes characteristics with lower broadband access significantly less likely to have a video vs phone visit
  – Spanish-speaking people less likely to have a video visit vs. phone visit

(FCC, 2020; Perzynski et al., 2017; Rodriguez et al., 2021)
Stage 2: Access

How do differences arise?

Red: Census block groups poverty rate >35%

Green: AT&T VDSL or FTTH at max advertised download speeds of 18 mbps+

(June 2016)

(Benda, Veinot, Sieck & Ancker, 2020)
Stage 2: Access

How do differences arise?

- Android devices more common among low-income people and African Americans
- Telehealth applications may not be available for Android devices

(Statista, 2013)

Preparing for Your Video Visit

To participate in a video visit you will need:
- A smartphone or tablet (not a computer)
- An active MyUofMHealth Patient Portal account
- The MyUofMHealth mobile app downloaded on your smartphone or tablet
- A strong wireless or cellular data connection
- To be in the state of Michigan at the time of the appointment.

Choose a location that is safe, comfortable, private and well lit for your video visit.
- Test your app connection in that location before your appointment.
  - Log in to the MyUofMHealth mobile app on your smartphone or tablet.
  - If you are using the MyChart app, or using the MyUofMHealth app on an Android device, you may not be able to test the video connection.
Stage 2: Access

How do differences arise?

• Incomplete Spanish versions of technology
  – Patient portal registration material arrives in English despite Spanish preference
  – Video visit testing and visit notifications only in English
  • “They can't read English. So when they get the text message about the waiting room in [name of program], they don't even know that they're supposed to click on it or what they're supposed to do with it.” (P5, NP)
Stage 2: Access

Precautions to avoid IGI
Stage 2: Access

Precautions to avoid IGI

Firme el documento de consentimiento de telesalud en su Portal de Paciente

1. Ve a: https://covent.communitycare.org/welcome/patient-portal/
   Elige "Medical Patient Portal"

Our medical patient portal offers information about your health and allows you to communicate with your Covenant clinic.

In our Patient Portal, you can:

- Email Your Doctor
- View Current Medications
- View Prescriptions
- Request an Appointment
- View Lab Results
- View Future Appointments
- View Health Summaries

Medical Patient Portal
Dental Patient Portal
STAGE 3: UPTAKE —
Who adopts health informatics interventions (when there is access)
Stage 3: Uptake

(Anthony, Campos-Castillo & Lim, 2018)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All (N = 2,325)</th>
<th>Used a portal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Used</td>
<td>No</td>
</tr>
<tr>
<td>Offered access by health care provider or insurer**</td>
<td>Yes</td>
<td>603%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>39.7</td>
</tr>
<tr>
<td>Sex**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>539</td>
<td>58.5</td>
</tr>
<tr>
<td>Male</td>
<td>461</td>
<td>41.5</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>689</td>
<td>71.3</td>
</tr>
<tr>
<td>Non-Hispanic black</td>
<td>133</td>
<td>10.7</td>
</tr>
<tr>
<td>Hispanic</td>
<td>98</td>
<td>9.1</td>
</tr>
<tr>
<td>Non-Hispanic other</td>
<td>80</td>
<td>8.8</td>
</tr>
<tr>
<td>Age (years)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-30</td>
<td>15.9</td>
<td>15.7</td>
</tr>
<tr>
<td>31-40</td>
<td>15.7</td>
<td>16.9</td>
</tr>
<tr>
<td>41-50</td>
<td>20.2</td>
<td>23.8</td>
</tr>
<tr>
<td>51-64</td>
<td>28.6</td>
<td>28.1</td>
</tr>
<tr>
<td>65 or older</td>
<td>19.6</td>
<td>15.6</td>
</tr>
<tr>
<td>Education**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>College or more</td>
<td>390</td>
<td>51.2</td>
</tr>
<tr>
<td>Some college</td>
<td>338</td>
<td>31.3</td>
</tr>
<tr>
<td>High school or less</td>
<td>272</td>
<td>17.5</td>
</tr>
<tr>
<td>Employment status**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>605</td>
<td>68.1</td>
</tr>
<tr>
<td>Not employed</td>
<td>395</td>
<td>31.9</td>
</tr>
<tr>
<td>Location**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>849</td>
<td>88.6</td>
</tr>
<tr>
<td>Rural</td>
<td>15.1</td>
<td>11.4</td>
</tr>
<tr>
<td>Insurance type**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private</td>
<td>61.4</td>
<td>71.8</td>
</tr>
<tr>
<td>Medicaid*</td>
<td>18.2</td>
<td>11.1</td>
</tr>
<tr>
<td>Medicare</td>
<td>18.7</td>
<td>15.8</td>
</tr>
<tr>
<td>Other</td>
<td>1.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Has a regular health care provider**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>75.9</td>
<td>85.2</td>
</tr>
<tr>
<td>No</td>
<td>24.1</td>
<td>14.8</td>
</tr>
</tbody>
</table>

(Anthony, Campos-Castillo & Lim, 2018)
Stage 3: Uptake

How do differences arise?

Uptake influenced by usability and digital literacy barriers:

<table>
<thead>
<tr>
<th></th>
<th>Limited Health Literacy</th>
<th>Adequate Health Literacy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean # portal tasks completed without assistance</td>
<td>1.3</td>
<td>4.2</td>
</tr>
<tr>
<td>% of participants with novice computer barrier</td>
<td>69%</td>
<td>10%</td>
</tr>
</tbody>
</table>

(Tieu et al., 2017)
Stage 3: Uptake

How do differences arise?

(In Veinot et al., 2013).
## Stage 3: Uptake

**Precautions to avoid IGI**

<table>
<thead>
<tr>
<th>Step</th>
<th>Task</th>
<th>Tools Used</th>
<th>Initiated by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Requesting appointment</td>
<td>Phone, Web Portal</td>
<td>Patient, Staff</td>
</tr>
<tr>
<td>2</td>
<td>Pre-appointment call with staff</td>
<td>Phone</td>
<td>Staff</td>
</tr>
<tr>
<td>3</td>
<td>Validating insurance</td>
<td>Phone</td>
<td>Patient</td>
</tr>
<tr>
<td>4</td>
<td>Registering for patient portal</td>
<td>Email/Text, Web Portal</td>
<td>Staff, Patient</td>
</tr>
<tr>
<td>5</td>
<td>Consenting to telehealth</td>
<td>Web Portal</td>
<td>Reminder</td>
</tr>
<tr>
<td>6</td>
<td>Check-in</td>
<td>Phone</td>
<td>Staff</td>
</tr>
<tr>
<td>7</td>
<td>Being in the right place at the right time</td>
<td>--</td>
<td>Patient</td>
</tr>
<tr>
<td>8</td>
<td>Noticing and clicking visit call/link (nudge)</td>
<td>Mobile Phone, Text</td>
<td>Patient</td>
</tr>
<tr>
<td>9</td>
<td>Accepting telehealth permissions</td>
<td>Mobile Phone</td>
<td>Software</td>
</tr>
<tr>
<td>10</td>
<td>Waiting in waiting room</td>
<td>Mobile Phone</td>
<td>Software</td>
</tr>
<tr>
<td>11</td>
<td>Interacting with provider</td>
<td>Mobile Phone</td>
<td>Software</td>
</tr>
<tr>
<td>12</td>
<td>(Troubleshooting with provider)</td>
<td>Mobile Phone</td>
<td>Staff</td>
</tr>
<tr>
<td>13</td>
<td>Making a payment/co-payment</td>
<td>Web Portal</td>
<td>Reminder</td>
</tr>
<tr>
<td>14</td>
<td>Determining next steps (e.g., referrals)</td>
<td>Web Portal, Mail</td>
<td>Patient, Staff</td>
</tr>
<tr>
<td>15</td>
<td>Scheduling follow-up appointments</td>
<td>Phone</td>
<td>Staff</td>
</tr>
</tbody>
</table>
Stage 3: Uptake
Precautions to avoid IGI

- Adding resources: Intermediaries
  - “I think some coaching...more than what the front desk and the nurses and even myself can do would be really helpful just to make sure that it's efficient in joining the meeting.” (P3, PA, FQHC)
  - Intermediaries assist in technology use for people with little prior experience, especially older adults
  - Importance of empathy and warmth

(Bakardjieva, 2005; Barnard et., 2013; Francis et. al., 2018; Hunsaker et. al, 2019; Selwyn et. al, 2016; Taipale, 2019)
Stage 3: Uptake

Precautions to avoid IGI
STAGE 4: ADHERENCE —
Ongoing usage of health informatics interventions
Stage 4: Adherence

Mental Health
- Internet-Based Relaxation RCT (Alfonsson et al. 2016)
- Web-based Psychotherapy Interventions RCT (Karyotaki et al. 2015)

Smoking
- Quitting via web-based and/or phone (Nash et al. 2015)
- Web-based quitting (Strecher et al. 2008)
- Mobile app for cessation (Ey et al. 2015)

Alcohol Consumption
- Adherence & retention for web-based intervention (Murray et al. 2013)
- Web-based game for adolescents (Jander et al., 2016)

Physical Activity and Nutrition
- Web based weight loss program (Svensson et al. 2014)
Stage 4: Adherence

• Analysis of video call logs at FQHC

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Distinct Visits</th>
<th>Visits with Dropped Calls</th>
<th>% Visits with at Least One Dropped Call</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>4311</td>
<td>1451</td>
<td>33.66%</td>
</tr>
<tr>
<td>2021</td>
<td>1579</td>
<td>368</td>
<td>23.31%</td>
</tr>
</tbody>
</table>
Stage 4: Adherence

How do differences arise?

Health Literacy and Numeracy

(Ancker, 2017)
Stage 4: Adherence

How do differences arise?

- Satisfaction: How pleasant is it to use the design?
- Learnability: How easy is it for users to accomplish basic tasks the first time they encounter the design?
- Memorability: When users return to the design after a period of not using it, how easily can they reestablish proficiency?
- Efficiency: Once users have learned the design, how quickly can they perform tasks?
- Errors: How many errors do users make, how severe are these errors, and how easily can they recover from the errors?

(Rossler, 2015)
Stage 4: Adherence

How do differences arise?

- Technical problems during calls
  - “…we started talking, about within 30 seconds to a minute, we can no longer hear each other. So we were just kind of doing sign language…So I was telling her how to turn the audio of hers on and off, because I found that that helps a lot. And then I was also turning the audio of mine on and off, but it didn't work. She rejoined the meeting and then I rejoined the meeting and still didn't work. But then when I rejoined the meeting, second time, it did work, but it was just kind of frustrating. That happens…a couple of times throughout the day…If we still can't figure it out, even though we both rejoined and left and turned the audio on, then I'll just say, I'm going to call you.” (P2, PA)

- Switches to phone after 5 minutes
  “…if it's not working then…we just call them. (P5, NP)
Stage 4: Adherence

Precautions to avoid IGI

(Ancker, 2017; Broderick et al., 2014)
Stage 4: Adherence

Precautions to avoid IGI

(Unertl et al., 2016)
## Stage 4: Adherence

**Precautions to avoid IGI**

<table>
<thead>
<tr>
<th>Design element</th>
<th>Some affected groups</th>
<th>Example</th>
<th>Relevant literature</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interaction design</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modes of input</td>
<td>Deaf people, People with cognitive impairments, people with low literacy</td>
<td>Due to literacy challenges, Deaf people may be more able to input information using icon selection and manipulation</td>
<td>118–121</td>
</tr>
<tr>
<td>Error handling</td>
<td>People with cognitive impairments, people with low literacy, seniors</td>
<td>People with low literacy make more spelling errors; thus search interfaces should have high error tolerance regarding spelling</td>
<td>118, 122</td>
</tr>
<tr>
<td><strong>Information architecture</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>People with Cognitive Impairments, Seniors</td>
<td>Due to memory issues, seniors find it easier to find information within a system with a shallow information hierarchy</td>
<td>123, 124</td>
</tr>
<tr>
<td><strong>Information design</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visual presentation of information</td>
<td>Blind people, deaf people, people with low literacy, seniors</td>
<td>Tonal feedback can ensure comprehension of graphs and data visualizations by blind people</td>
<td>115, 125–127</td>
</tr>
<tr>
<td>Auditory presentation of information</td>
<td>People with cognitive impairments, people with low literacy, seniors</td>
<td>People with low literacy or cognitive impairments may better comprehend textual information accompanied by audio narration</td>
<td>126, 128, 129</td>
</tr>
<tr>
<td><strong>Interface design</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Layout</td>
<td>Blind people, seniors</td>
<td>For seniors, information should be placed in the center of the screen so as to address reduced peripheral vision</td>
<td>130, 131</td>
</tr>
<tr>
<td>Buttons and icons</td>
<td>People with cognitive impairments, seniors</td>
<td>Older adults may find it easier to tap on larger buttons and icons</td>
<td>132, 133</td>
</tr>
<tr>
<td>Navigation design</td>
<td>Blind people, people with low literacy, seniors</td>
<td>People with low literacy find it easier to navigate within mobile applications that use linear (versus hierarchical) navigation</td>
<td>131, 134, 135</td>
</tr>
</tbody>
</table>
STAGE 5: EFFECTIVENESS —
How well, and for whom, informatics interventions work in the “real world”
Stage 5: Effectiveness


(Gomes & McGuire, 2001)
Stage 5: Effectiveness

- Informatics intervention strategies for reducing disparities
  - Prompting actions
  - Default care processes
  - Provider self-regulation
Prompting via reminders

• Race, gender and equity effects for diabetes care are mixed:
  – Prompting screening actions – 3 studies:
    • Screening for smoking, diabetes, cancer – may favor disparity groups (1 study) or have no effect (2 studies)
      (Cato, Hyun & Bakken, 2014; Mishurish & Linder, 2014; Zera et. al, 2015)
  – Prompting treatment actions – 2 studies:
    • Neutral or mixed effects on equity in process outcomes
    • No impact on intermediate health outcomes
      (Jean-Jacques et. al, 2011; Hicks et al., 2008)
## Default care processes: Order sets, care pathways

<table>
<thead>
<tr>
<th>Differential Effects</th>
<th>Disparity Group</th>
<th>Intervention Description</th>
<th>Study Type</th>
<th>Setting</th>
<th>Outcome(s)</th>
<th>Citation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Effect (Targeted Intervention)</td>
<td>South Asian Immigrants Low SES (Medicaid)</td>
<td>Order Sets (Culturally tailored), Alerts (Used less: Registries, Feedback)</td>
<td>Stepped-wedge quasi-experiment</td>
<td>14 primary care practices</td>
<td>Treatment Effects: Practice Level: Improvement in BP control Medicaid patients: Reduction in SBP and DBP</td>
<td>(Lopez et. al, 2019)</td>
</tr>
<tr>
<td>Positive Effect (Targeted Intervention)</td>
<td>Cambodian Immigrants and Refugees</td>
<td>HIT mental health screening and care pathway</td>
<td>CRCT</td>
<td>18 primary care providers</td>
<td>Treatment Effects: Increased depression and PTSD diagnosis More guideline-concordant and trauma-informed care</td>
<td>(Sorkin et. al, 2019)</td>
</tr>
</tbody>
</table>
## Audit and Feedback

<table>
<thead>
<tr>
<th>Differential Effects</th>
<th>Disparity Group</th>
<th>Intervention Description</th>
<th>Study Type</th>
<th>Setting</th>
<th>Outcome(s)</th>
<th>Citation</th>
</tr>
</thead>
</table>
| Favors advantaged groups | White vs. Blacks | Population and practice-level comparative feedback, Registries | Descriptive, No control group | 198 primary care practices | Favors Whites: BP Control  
Favors non-Hispanics: BP control  
Favors high SES: BP control | (Fortuna et. al, 2018) |
Stage 4: Adherence

*How do differences arise?*

- Intervention strategy may matter:
  - prompting actions
  - default care processes
  - audit and feedback

- Emphasis on individual behavior change vs. defaults in systems?

- Effectiveness differentials may be rooted in poor access, uptake, or adherence

*(Vasquez, 2021)*
Stage 5: Effectiveness

Precautions to avoid IGI

1. Identify equity-relevant independent variables
2. Choose at least one equity-relevant outcome variable
3. Report sociodemographics of:
   - those who participate
   - those who refuse (if possible)
   - those who are lost to follow up
4. Ensure sufficient statistical power for stratified, subgroup, or interaction analyses
5. Analyze effect of differential uptake and adherence rates on outcomes

Place of residence
Race/ethnicity/language
Occupation
Gender/sex
Religion
Education
Socioeconomic status (SES)
Social capital
Plus: Age, sexual orientation, disability

PROGRESS-PLUS

O’Neill Journal of Clinical Epidemiology 2014
Key Takeaways

• Health informatics interventions are at particular risk of fostering Intervention-Generated Inequalities (IGI)

• IGI can emerge at 5 stages of the intervention cycle

• Precautionary measures are necessary to guard against IGI emerging from informatics interventions
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References


