Controversies' in mortality

Robert Stout, Ph.D.
Chief Science Officer and Laboratory Director
The Face of Anti-selection

• Examples of anti-selection
  – Smoking, cotinine prevalence and mortality
  – Carcinoembryonic antigen
  – Self-reported heart disease and Nt proBNP
  – Opiates and marijuana

• Changes in population attitude.

The opinions presented are those of the author and may or may not represent those present in actuarial, individual underwriting or medical sections of the life insurance industry.
Fraud

- Insurance schemes are part of a modern global crime nexus that steals an estimated $1 trillion per year.¹
The Risk

- By their very nature, risks are constantly evolving in ways society is often unprepared to handle. As our environment changes, known risks are modified, new ones are formed and the insurance industry is presented with new opportunities to reduce, mitigate transfer risk. SwissRe 2018
Examples of Current and Changing Risk

• Smoking and mortality
• Vaping and e cigarette's
Self-reported Smoking and Urine Cotinine Concentration

<table>
<thead>
<tr>
<th>URINE COTININE (Binned)</th>
<th>% of cell</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;= 0</td>
<td>100.00%</td>
</tr>
<tr>
<td>6 - 10</td>
<td>99.00%</td>
</tr>
<tr>
<td>21 - 30</td>
<td>98.00%</td>
</tr>
<tr>
<td>41 - 50</td>
<td>97.00%</td>
</tr>
<tr>
<td>61 - 70</td>
<td>96.00%</td>
</tr>
<tr>
<td>81 - 90</td>
<td>95.00%</td>
</tr>
<tr>
<td>101 - 110</td>
<td>94.00%</td>
</tr>
<tr>
<td>121 - 130</td>
<td>93.00%</td>
</tr>
<tr>
<td>141 - 150</td>
<td>92.00%</td>
</tr>
<tr>
<td>161 - 170</td>
<td>91.00%</td>
</tr>
<tr>
<td>181 - 190</td>
<td>90.00%</td>
</tr>
<tr>
<td>201 - 210</td>
<td>89.00%</td>
</tr>
<tr>
<td>221 - 230</td>
<td>88.00%</td>
</tr>
<tr>
<td>241 - 250</td>
<td>87.00%</td>
</tr>
<tr>
<td>261 - 270</td>
<td>86.00%</td>
</tr>
<tr>
<td>281 - 290</td>
<td>85.00%</td>
</tr>
<tr>
<td>301 - 400</td>
<td>84.00%</td>
</tr>
<tr>
<td>501 - 600</td>
<td>83.00%</td>
</tr>
<tr>
<td>701 - 800</td>
<td>82.00%</td>
</tr>
<tr>
<td>901 - 1000</td>
<td>81.00%</td>
</tr>
</tbody>
</table>

% NO "I don't smoke"

200NG/ML

500NG/ML
Smoking Mortality Risk

• What is the current mortality risk for smoking
• While smoking prevalence has gone down the group that continues to smoke tend to be the heavier user with attendant higher mortality.
• CRL study of applicants from 1991 to 2015 with mortality through February 28, 2017
## Smoking Mortality Risk

### Table: Smoking Mortality Risk by Age and Cotinine

<table>
<thead>
<tr>
<th></th>
<th>AGE &lt;41</th>
<th></th>
<th></th>
<th></th>
<th>41-60</th>
<th></th>
<th></th>
<th>61+</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SMOKER</td>
<td>NO</td>
<td>TOTAL</td>
<td>SMOKER</td>
<td>NO</td>
<td>TOTAL</td>
<td>SMOKER</td>
<td>NO</td>
<td>TOTAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FEMALE</td>
<td>&lt;= 199</td>
<td>1</td>
<td>2.20</td>
<td>1.02</td>
<td>1</td>
<td>2.05</td>
<td>1.01</td>
<td>1</td>
<td>0.87</td>
</tr>
<tr>
<td></td>
<td>200+</td>
<td>3.21</td>
<td>4.71</td>
<td>4.33</td>
<td>3.52</td>
<td>4.45</td>
<td>4.22</td>
<td>2.38</td>
<td>2.69</td>
</tr>
<tr>
<td>MALE</td>
<td>&lt;= 199</td>
<td>1.04</td>
<td>4.24</td>
<td>1.26</td>
<td>1.06</td>
<td>4.07</td>
<td>1.29</td>
<td>1.03</td>
<td>2.21</td>
</tr>
<tr>
<td></td>
<td>200+</td>
<td>2.33</td>
<td>3.89</td>
<td>3.19</td>
<td>2.46</td>
<td>3.94</td>
<td>3.36</td>
<td>1.86</td>
<td>2.4</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1.09</td>
<td>3.62</td>
<td>1.32</td>
<td>1.08</td>
<td>3.68</td>
<td>1.31</td>
<td>1.04</td>
<td>1.85</td>
</tr>
</tbody>
</table>

CRL study of applicants from 1991 to 2015 with mortality through February 28, 2017
### Cox with Age and Sex as Covariants

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Exp(B)</th>
<th>95.0% CI for Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>AGE</td>
<td>1.101</td>
<td>1.101</td>
</tr>
<tr>
<td>COTININE</td>
<td>2.867</td>
<td>2.840</td>
</tr>
</tbody>
</table>
New Threat

• Vaping and e cigarettes
Most adult e-cigarette users report currently using other tobacco products. According to data from Wave 1 of the PATH survey, among current users of e-cigarettes, 69.7 percent were current smokers, 8.6 percent quit smoking combustible tobacco cigarettes within the past year, and 5.7 percent were former smokers (abstained from smoking for more than 1 year) (Coleman et al., 2017).
Conclusion 7-1. There is **substantial evidence** that e-cigarette aerosols can **induce acute endothelial cell dysfunction**, although the long-term consequences and outcomes on these parameters with long-term exposure to e-cigarette aerosol are uncertain.

Conclusion 9-2. There is **substantial evidence** that **heart rate increases** shortly after nicotine intake from e-cigarettes.

Early Mortality

- There is a consistent increased prevalence of early cancer claims compared to predicted national cancer mortality.
CEA in the Insurance Applicant Population

• Carcinoembryonic antigen (CEA) is a blood test for monitoring cancer therapy and or cancer recurrence.

• The test is used in the industry to identify early mortality risk in applicants 50 years of age and older.
### CEA and Mortality

<table>
<thead>
<tr>
<th>CEA</th>
<th>VITAL STATUS</th>
<th>MORTALITY</th>
<th>FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ALIVE</td>
<td>DEAD</td>
<td>RATIO</td>
</tr>
<tr>
<td>&lt;=2.0</td>
<td>0.989</td>
<td>0.011</td>
<td>REFERANT</td>
</tr>
<tr>
<td>2.1-3.0</td>
<td>0.984</td>
<td>0.016</td>
<td>1.48</td>
</tr>
<tr>
<td>3.1-4.0</td>
<td>0.977</td>
<td>0.023</td>
<td>2.08</td>
</tr>
<tr>
<td>4.1-5.0</td>
<td>0.972</td>
<td>0.028</td>
<td>2.58</td>
</tr>
<tr>
<td>5.1-6.0</td>
<td>0.942</td>
<td>0.058</td>
<td>5.34</td>
</tr>
<tr>
<td>6.1-7.0</td>
<td>0.927</td>
<td>0.073</td>
<td>6.74</td>
</tr>
<tr>
<td>7.01-10</td>
<td>0.922</td>
<td>0.078</td>
<td>7.21</td>
</tr>
<tr>
<td>10.1-20.0</td>
<td>0.894</td>
<td>0.106</td>
<td>9.80</td>
</tr>
<tr>
<td>&gt;20</td>
<td>0.739</td>
<td>0.261</td>
<td>24.13</td>
</tr>
<tr>
<td>TOTAL</td>
<td>616,895</td>
<td>9128</td>
<td>1.48</td>
</tr>
</tbody>
</table>
CEA Levels vs. Face Amount Applied For

Why does face amount go down as CEA goes up??????

<table>
<thead>
<tr>
<th>CEA</th>
<th>Dollars</th>
<th>Affected</th>
<th>% pop</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;6.0</td>
<td>$2,086,936,410.00</td>
<td>5804</td>
<td>0.98%</td>
</tr>
<tr>
<td>&gt;10</td>
<td>$387,946,727.00</td>
<td>1202</td>
<td>0.20%</td>
</tr>
</tbody>
</table>
Mortality Risk and Nt proBNP

• It is used to classify risk of heart failure and has been shown to indicate mortality risk in other forms of heart disease independent of EKG tracings.

• Only half of applicants with Nt proBNP values greater than 1000 ng/ml report they have heart disease.
Opiate Epidemic and Marijuana

• The number of companies testing for a broad array of members of the opiate family continues to increase.
• So has the testing for marijuana.
Opiate Mortality

• No insurance mortality is currently available, however, reports from client companies indicate an increase incidence of “opiate associated findings on death certificates”.

• Currently 130 people die a day from opiate overdose. 67,000 in 2017.
CRL Marijuana study

• 500,060 applicants (3,569 deaths by SS DMF, May 2017) were tested for THC-COOH from 1995 to 2015 at CRL.

• Able to determine a mortality ratio for test pos. vs. test neg. by multivariate analysis including age, sex and smoking status as needed by Cox regression methodology.
  – Applicants testing positive for other illicit drugs excluded from primary analysis.
Percent of THC-COOH tests Positive (of the pool tested)

<table>
<thead>
<tr>
<th>THC POSITIVES</th>
<th>Male</th>
<th>Female</th>
<th>population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco Smoker</td>
<td>52%</td>
<td>54%</td>
<td>13%</td>
</tr>
<tr>
<td>Non-smoker</td>
<td>48%</td>
<td>46%</td>
<td>87%</td>
</tr>
<tr>
<td>Prevalence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age &lt;30</td>
<td>8.3%</td>
<td>3.3%</td>
<td>5.9%</td>
</tr>
<tr>
<td>Age 61-70</td>
<td>2.0%</td>
<td>0.7%</td>
<td>1.4%</td>
</tr>
<tr>
<td>average</td>
<td>4.1%</td>
<td>1.7%</td>
<td>3.1%</td>
</tr>
</tbody>
</table>
Mortality Ratio for THC-COOH Positive tests vs. neg.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-smoker</td>
<td>1.7</td>
<td>2.6</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(95% CI 1.3-2.3)</td>
<td>(95% CI 1.5-4.6)</td>
<td></td>
</tr>
<tr>
<td>Smoker</td>
<td>-</td>
<td>-</td>
<td>1.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(95% CI 0.85-1.3)</td>
</tr>
<tr>
<td>All age ≤50</td>
<td>-</td>
<td>-</td>
<td>2.36</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(95% CI 1.96-2.8)</td>
</tr>
<tr>
<td>All age &gt;50</td>
<td>-</td>
<td>-</td>
<td>1.74</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(95% CI 1.3-2.3)</td>
</tr>
</tbody>
</table>

Age always included as covariate.
Sex and smoking status included as covariates if not split.
Excludes those with other illicit drugs.
Consumer Opinion and Reliance on Medical Records.

- Consumers are deeply concerned about the cyber safety of their personal information in the hands of medical providers.
- 70 percent of Americans distrust health technology, sharply climbing from only 10 percent in 2014;
- 89 percent of consumers with 2016 provider visits withheld health information during visits;
- 69 percent of patients say their primary-care physician doesn’t have enough technology prowess for them to trust divulging their personal information.

*(Black Book, January 2017)*
Changes in products and product underwriting

• While most consumers are truthful the few that are not will destroy product pricing

• While lowering the underwriting bar may facilitate easier, faster and lower initial cost to the direct company they will all result in higher cost for the re-insurance market; these will ultimately drive up the cost of insurance for everyone.
FUTURE CHALLENGES TO RISK ASSESSMENT

WE CAN'T COMPETE ON PRICE.

WE ALSO CAN'T COMPETE ON QUALITY, FEATURES OR SERVICE.

THAT LEAVES FRAUD, WHICH I'D LIKE YOU TO CALL MARKETING.
This presentation may contain confidential and proprietary information of Gen Re. You agree as a condition of our presentation to maintain such information in confidence, and not to reproduce or otherwise disclose this material to any third-party without our prior written permission. You also agree to restrict the distribution of this presentation to those persons within your company who are directly responsible for its evaluation.
• “Understanding human behavior is central to effective policies. Those that do not take the human aspect into account will not have the desired effect.” Ahmad F. Angawi & Wiam A. Hasanain, The Nuts and Bolts of Behavioral Insights Units

• “People often face decision-making environments that prevent them from making the best possible choices.”

• BE studies can help increase disclosure rates for insurance applications, exams and tele-interviews.
Fraud and Behavioral Economics

Fraud studies show that levels of honesty are decreasing. Q1, 2018, one insurer, noted it avoided over $200 million in risk, directly attributable to known fraudulent business.

How can BE help?
Employee/Underwriter Analytics
Producer Analytics
Form Design
Employee Behavior – Potential Red Flags

- Never sick; don’t take company holidays off
- No vacation; don’t want others doing their work
- Work odd hours when others are not present
- Frequently volunteer to handle other cases
- What can be done?
Analyzing Underwriter Behavior

- **Audit** of course!!!
- **Emails & phone calls**
- **Case distribution** by production source
- **Assessment patterns**; expected based on business mix
- **Placed%**, deviation from dept. norm
- **Offer%**, deviation from dept. norm
Analyzing **Underwriter** Behavior

- **Cases per day, pages per day**
- **Time service**, overall and by producer, deviation from dept. norm

<table>
<thead>
<tr>
<th>UW</th>
<th>Pgs</th>
<th>Pgs/day</th>
<th>Deviation</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>394,297</td>
<td>1764</td>
<td>135.4%</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>365,213</td>
<td>1656</td>
<td>127.2%</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td>356,920</td>
<td>1622</td>
<td>124.6%</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>348,693</td>
<td>1592</td>
<td>122.2%</td>
<td>4</td>
</tr>
<tr>
<td>19</td>
<td>190,852</td>
<td>1521</td>
<td>116.8%</td>
<td>5</td>
</tr>
</tbody>
</table>
Compare to sales force averages: extreme outliers

- disclosure rates for key questions: cancer, cardiac/coronary, diabetes, nicotine
- Premium mode and payment method analysis
- Commission Annualization
- Gender and age distribution
- Face amount analysis
- Address analysis
- Beneficiary analysis
- Post-issue changes
• **For e-apps, D2C business, and call centers** must have metrics in place to understand disclosure rates.

• **D2C – consumer specific data**: disclosure rates for key questions; per question elapsed time; questions that prompt hang ups or discontinuation of an e-app

• **Talk with tele-interviewers**: which questions do they perceive prompt customers to stop and think? Which do customers rush through or struggle with? Which do they over disclose on?

• **Measure disclosure rates per tele-interviewer**

• **Engage with the claims area** to see if any form design elements caused contestability challenges
Form Language

- **Form language** = simple and straightforward; avoid unnecessarily technical language.

- **For e-apps and self-service portals,** utilize pop ups to define required technical terms.


- Consider the **tone of form language** – is it inviting, upbeat, engaging?
M died of metastatic lung ca 4 months after policy issue.

Policy approved and mailed to client 11/30/2017, he signed delivery receipt and paid initial premium 12/20/2017.

Same day he signed delivery receipt he went to urgent care for chest pain. CXR = diagnosis of pneumonia and a lung mass.

Admitted to hospital the same day; stated had been having chest pain on & off for months. Notes doing poorly for a month with progressive dyspnea.
• "In the past 10 years, have you been diagnosed, treated, tested positive for, or been given medical advice by a professional health care provider for any of the following:"

• An alternative approach: In the past [10] years or have you ever, had, been diagnosed, treated, tested positive for, or been given medical advice by a professional health care provider for any of the following: (inclusion of the word “had” is critical if possible as it helps avoid situations where someone has an illness or symptoms such as chest pain, but does not seek medical care/advice.)
Does Form Design Really Prevent Fraud?

The Policy Delivery Acknowledgment, "the person proposed for insurance under this policy is living and insurable as described in each part of the application for this policy."

1. Has the proposed insured had any change in health or insurability or received advice, treatment or testing from a professional health care provider since completion of the application or medical examination for this coverage? ___Yes ___No

2. Does the proposed insured have any pending appointments, lab work or tests with a professional health care provider? ___Yes ___No
Does Form Design Really Prevent Fraud?

- M who died a couple of weeks after the policy was issued by accidental prescription toxicity and alcohol use while traveling on an airplane.
- Felony conviction for drugs '01 with no time served and probation that ended 2004.
- Claims investigation: client was under house arrest for a significant white collar felony and awaiting trial at time of application.
- "Have you ever been **convicted** of a misdemeanor or felony?"

1. In the past [10] years, have you: (If “Yes”, provide full details, including dates)
   a) Plead guilty to or been convicted of a felony? ___ Yes ___ No
   b) Been on parole or probation? ___ Yes ___ No

2. Do you have any criminal charges pending? ___ Yes ___ No
Thank you

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Evolution Of Fraud

Risks Are Growing In Complexity
Impact of Fraud Without MDS

LIFE

UNDERWRITING

5.9%

Of New Life Insurance Sales

CLAIMS

10%

Of Total Claims Paid

P&C

UNDERWRITING

3-5%

Of premium escalation

CLAIMS

10%

Of Total Claims Paid

LOST TO FRAUD

SOURCE:

1: RGA 2017 Claims Fraud Survey
2: Coalition Against Insurance Fraud
3: WNS Decision Point Survey

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Expertise Based Fraud Detection

AI DETECTION
Find fraud more accurately in real time

FRAUD EXPERTISE
Delivering innovative partnerships, data and technology that adds value

DECISION SUPPORT
Prioritize, take action and unlock operational efficiency

Hosted
Comprehensive & Customizable
Compliant
Modular

Applications/Active Policies/Claims
Not Just AI, MDS Ecosystem

Strategic Initiatives & Partners

- Payment
- Medical
- E-Commerce
- Public Data
- eApplication
- State DOI & NAIC
- Social
- Device
- Surveillance
- Agent
- FINRA

Information Sharing Database

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MDS Approach

**External Data**
- Public Record Databases
- State Regulators
- FINRA, State Regulators
- Criminal Records
- E-commerce
- Payments
- Best Practices
- Industry Conferences
- Emerging Business Trends
- Emerging Fraud Trends
- Fraud News and Social Media

**Your Data**
- Policies
- Claims
- Insurance Applications
- Agents
- Fraud
- Devices
- Payments
- Unstructured (i.e. client notes)

**MDS Fraud Detection Engine**
- Supervised Learning
- Unsupervised Learning
- MDS AI’s Global Learnings
- Fraud Expertise driven data enhancements

**Output**
- Fraud Risk Score
- Fraud Risk Level
- Allegation
- Actionable Steps

**System Integrations**
- Underwriting
- Policy Administration
- Claims
- Dashboards

**Secondary Interface**
- Web
Impact On Metrics With MDS Expertise

- **IMPROVED DETECTION BY 220%**
- **ACCURACY RATE 80%+**
- **SAVED FORTUNE 100 LIFE CARRIER $235 M**

*Figures based on MDS team’s professional experience*
*Standard machine learning accuracy rate as published by ICMLA, 2017*
Who We Are

35+ Years
Fraud Expertise

TEAM HAS
75 YRS
Combined Experience In
Insurance And Technology

AI system design
EXPERTS

STRATEGIC PARTNERS, NOT VENDORS

EXPERIENCE WITH LARGEST

INSURANCE COMPANIES

Cigna
MetLife
New York Life
AIG
Columbia Business School
Columbia University
Plug and Play

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