

SCORviews

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MESSAGE FROM THE SCOR GLOBAL LIFE AMERICAS CEO



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Innovations in Underwriting – A Path to the Future

Underwriting, more than other functional areas, has come to epitomize the need for life insurers to modernize operations to meet changing customer expectations and avoid the risk of disruption from outside the industry. Given the availability of data sources, new health assessment technology, predictive analytics and so on, underwriting is an obvious place to invest in innovation. Life insurers are doing that, and SCOR is committed to supporting these efforts wherever we can.

Underwriting expertise and innovation are essential components of our full-service approach to life reinsurance. We place a high priority on working with clients to advance efficiencies in traditional underwriting and develop next generation underwriting.

This past year we forged ties with innovators in data solutions, health and wellness platforms and health risk profiling. Through these investments and partnerships, we can share insights with clients about the potential of new technologies to improve underwriting and better manage inforce business. We also can connect clients with new players and help in the execution of pilot programs and R&D initiatives.

This is an exciting time to be involved in underwriting. Like underwriters throughout the industry, the team at SCOR is working in a variety of ways to demonstrate how their profession is moving life insurance into the future. In this issue of *SCORviews*, members of our Underwriting Research area share learnings...

- Cindy Mitchell and Peter Komsthoeft recap various underwriting systems and programs in use today and clarify confusing and often misused terminology for automated underwriting, accelerated underwriting, simplified issue and predictive modeling.
- Maria Beaulieu provides an overview of the current state of electronic health records in life insurance.

Also in this issue, Bruce Miller addresses the expert judgement process and how SCOR applies expert judgement to help in our assessment of mortality improvement trends. And rounding out the issue, Dr. James Kadouch, who recently delivered a *SCORcast* life insurance webinar on Broken Heart Syndrome, follows up with an article on the topic.

We look forward to joining clients and other industry colleagues in New Orleans for the annual conference of the Association of Home Office Underwriters. I'm sure this year's agenda will drive home the reality that our industry – and underwriting in particular – is undergoing a major and much anticipated transformation.

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SCOR
The Art & Science of Risk

Harnessing the Differences

Underwriting in the US life insurance industry has had more change in the last five years than it has in the prior 30...and many underwriters are struggling to keep up with the pace. Terms like accelerated underwriting, automated underwriting, simplified issue, predictive models and big data are bounced around at industry meetings like ping pong balls. If you are confused by all the new terminology, you are not alone.

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Understanding the Terms

Accelerated and automated underwriting are often used interchangeably in published articles and among senior executives. Both imply FAST, so logically it makes sense to think they are the same thing. However, accelerated underwriting and automated underwriting have different meanings.

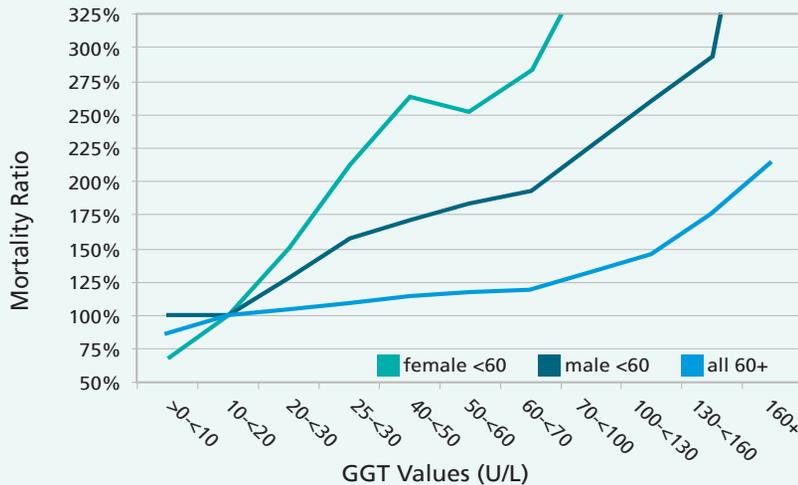
Automation/Automated Underwriting: In the simplest terms, automated means no human underwriter involvement needed. Automated underwriting essentially automates what a human underwriter has traditionally done. For example, Velogica® is SCOR's automated underwriting engine which has the ability to render an underwriting decision in less than a minute without the use of an underwriter.

Accelerated Underwriting (AUW) may or may not include automation. "Accelerated" means that a certain percentage of lower risk applicants are "accelerated" through the underwriting process without some of the traditional requirements, such as fluids (blood, urine, vitals). These applicants typically do not have any significant medical conditions that would prompt the need for additional requirements.

With AUW programs, a comprehensive application is used, and preferred classes are commonly available. The price is very close to, if not the same as, a fully underwritten product. Additional data sources are often used to help offset the protective value of fluids. One of the challenges of AUW is determining how best to funnel applications to the fluidless or traditional path.

Simplified Issue (SI) is sometimes confused with accelerated underwriting since neither involve the collection of fluids. However traditional SI and AUW are actually very different. SI typically has a limited number of application questions with a mortality load built into the product and preferred classes are not available. The resulting price is much higher than traditional full underwriting.

Figure 1: Varying thresholds by age and gender



This graph illustrates how thresholds vary by age and gender. For those under age 60, the mortality starts increasing around the age of 20. However, underwriting manuals typically ignore thresholds less than 100-130, even allowing the best preferred class. This flaw exists with virtually every variable used in underwriting.

Source: 2008 Journal of Insurance Medicine J Insur Med 2008;40:191-203

Gammo-Glutamyl Transpeptidase, a screening test for liver damage

Predictive Models

So where do **predictive models** come in? Predictive models are often used in conjunction with accelerated underwriting programs, but they can exist anywhere. There are various types of predictive models being deployed in the market today. Mortality, underwriting class and/or the probability of smoking are the most common targets being modeled currently. Some carriers have built their own predictive models to either predict underwriting class (without fluids) or actual mortality. Credible predictive models require a significant amount of data. Often life insurance carriers have to look for third parties in search of such data.

Credit scores are being used by many carriers. These scores provide a numerical value associated with the degree of relative mortality risk. However, since the inputs in the model differ from what the industry has used historically in underwriting, the score may not align with how the underwriter assessed the risk. This disconnect often creates confusion. This does not mean that either the underwriter or model is wrong though! Both approaches simply aggregate applicants into different 'buckets'. The credit-based mortality models aggregate people with favorable credit/financial factors, while the underwriter aggregates people with favorable personal history and biometric parameters.

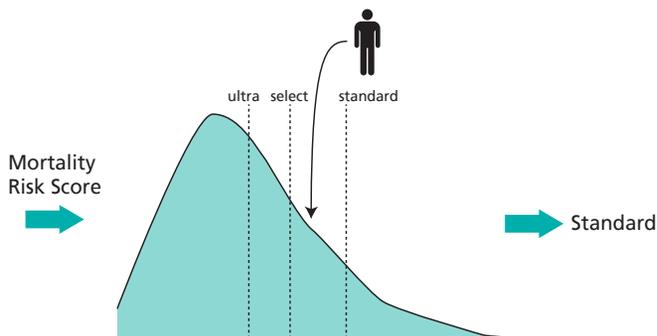
Since underwriters are naturally very analytical, it is completely natural to question how a model can possibly be better than a human underwriter at assessing risk. Before you shake your head in disbelief, it's important to understand how underwriting guidelines and preferred criteria were initially developed. Since the start of preferred class insurance underwriting, clinical medical research such as Framingham and the Build and BP study of 1979 have been used to develop underwriting guidelines and criteria. Preferred underwriting criteria such as build, BP and cholesterol levels were determined to be usable factors based on these studies.

Driven in significant part by mortality research by Exam One and Clinical Reference Lab the environment changed around 2012. These companies used their large data pools and combined them with mortality feedback through the Social Security Death Masterfile (SSDMF). Lab scoring such as Risk IQ and Smart Score were born. The results were shocking to many underwriters—the criteria underwriters had been using for years were not the strongest mortality predictors. Many applicants who received preferred rates actually had risk profiles more indicative of standard or even substandard mortality expectations.

Harnessing the Differences

■ ■ ■ Cont.

FIGURE 2: HISTORICAL DISTRIBUTION OF RISK SCORES FOR 35-YEAR-OLD, NON-SMOKING MALES



In addition to not using the strongest mortality predictors, most companies do not have different thresholds based on age and/or gender. These factors coupled with the use of traditional knock out methodologies created a risk classification system that was less effective than desired.

As a result, there has been significant overlap of individual mortality within traditional preferred classes. However, there is one benefit – because the system is inefficient, it is at the same time highly resistant to the effect of small changes in criteria (frequently prompted more by competition than data analysis). While not designed that way, it has actually ‘protected’ the industry to some degree from the many capricious changes to criteria over time.

Predictive models attempt to correct inefficiencies that exist today. Armed with new statistical techniques, companies with significant data can now create a better mortality model that incorporates a risk ranking system for age/gender cohorts based on actual mortality. New correlations can be discovered that are grounded in data specific to the insurance buying population and not primarily on medical research on general population studies.

A Predictive Model Example

Consider the predictive model created by one of the US’s largest direct writers. The model uses all underwriting inputs to arrive at an underwriting decision -- not just labs or credit-based attributes seen in other predictive models. The proprietary mortality risk scoring engine was trained on a comprehensive, historical data set of application data using advanced statistical and machine learning models of survival. The model estimates an applicant’s mortality risk conditional on 50+ features drawn from fluid lab tests, personal and family health history and ground-truth survival data.

Two primary modelling techniques (Cox Proportional Hazard and Random Survival Forest) were used. Both models score all individuals and then organize them into underwriting classes to maintain the same empirical distributions by age, sex and issue year. The model output is mapped into underwriting classes based on thresholds used during the development of the model to generate survival curves which appear to match or beat the actual curves from traditional underwriting.

Change and complexity is the new norm. While new concepts and terminology may appear overwhelming, embrace it! Data is the new currency and it is time to challenge our old way of thinking. Prepare yourself for changes: Consider taking a course on statistics or modelling. Sit down and talk to a data scientist or statistician to gain insight from their perspective. As the old adage goes, knowledge is power!

Partners in Innovation

SCOR is forming partnerships around the world to advance next generation underwriting and health & wellness programs. Our pilot programs and R&D efforts are connecting our reinsurance clients to new players from outside the industry. It's important for us to be at the forefront of change... to tap into innovation taking place outside the industry and make its value available to our clients.

Using Expert Judgement to Assess Mortality Trends

As a leader in Life reinsurance, SCOR is committed to deepening our understanding, advancing our practices and sharing our learnings in the area of mortality improvement. In keeping with our commitment to knowledge leadership in this area, SCOR Global Life launched a significant initiative in 2018 dedicated to Global Mortality Improvement (GMI).

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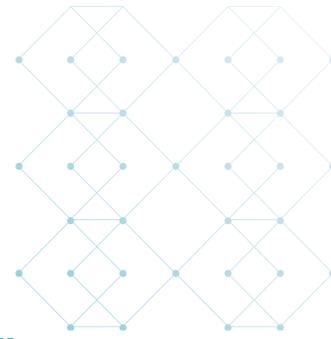
During the Global Mortality Improvement initiative, SCOR assessed trends in mortality improvement and quantification in the basis risk (the mis-estimation of the difference in mortality experience between general and insured populations) between insured, reinsured and population mortality with the goal to improve mortality forecasting for mortality products.

To complement our primary objectives, SCOR performed two expert judgement studies to collect opinions from both insurance professionals and the medical community. The objective of both studies was to advance the collective knowledge of both SCOR and the study participants on the topic of mortality risk, including causes of death and potential changes in lifespan in the future due to medical advances, behavior changes, public policy, socioeconomic and other factors.

Delphi Study

The first of these studies was a Delphi Study. The Delphi Study method is a structured communication technique developed as a systematic, interactive forecasting method which relies on a panel of experts. The aim is to gain a level of consensus by surveying the experts in multiple rounds of questions, allowing the experts to review responses from the other experts at the end of each round.

In general, the expectation is that mortality improvement is and will continue to be higher for the insured population.



Participants in the Delphi Study are subject matter experts in the area of mortality improvement who shared an understanding of these characteristics:

- Medical, cultural, political, social, legal and demographic impacts on mortality
- Medical advances, including their implications on causes of death
- Mortality improvement and mortality experience analysis
- Mortality and mortality improvement assumption setting, including consideration of risk
- Approaches to using historical mortality data to estimate future mortality
- Risk classification

They answered questionnaires in two rounds after which we created a final research report.

Overall, responses in the Delphi Study showed varied opinions regarding future mortality improvement levels compared to recent historical experience. In general, the panelists expected mortality improvement levels to be similar in the short term (5 – 15 years). For mortality improvement by socioeconomic class, panelists expect it will expand in the short term and possibly converge over the longer term (16 to 40 years).

The largest positive drivers that contributed to improved mortality in recent history are medical advances and fewer smokers. The largest negative drivers are obesity (with the resulting impacts of related issues) and opioids/drug epidemic. There is consensus that mortality improvement for the insured population is different than the general population, mainly due to levels of education and income, access to healthcare and healthier lifestyles. In general, the expectation is that mortality improvement is and will continue to be higher for the insured population.

Mortality improvement will continue to differ for impaired lives; however, with future medical advancements the gap may begin to close to normal life expectancy. On average, panelists believe that the maximum duration (years from life insurance policy issue) at which mortality improvement rates should be applied is 30 years and the maximum attained age at which mortality improvement rates should be applied is 99.

Medical Expert Judgement Study

The second study executed was focused on Medical Expert Judgement. This study consisted of a single survey followed by phone interviews with 16 physicians/medical experts (internally and externally).

As one might expect, our medical experts consider obesity as the major risk to population mortality over the next decade, with most participants saying that it would have a high negative impact. Interestingly, there was less consensus 2.5 decades out, as a similar number thought that the impact of obesity would be high, medium or low. Opioids and illegal drugs were thought to have a medium negative impact in the near and medium term but were projected to have less impact in the longer time frames.

Medical innovations' impact may have been diluted by the fact that many different specific innovations were considered. Even so, the panel's consensus was that there would be a medium sized positive effect in the short term, and innovations in the prevention of disease were expected to hold sway in the longer term.

Another consensus arose around the causes of deaths that would increase in the future with Alzheimer's/dementia and heart failure. However, the modal age at death is expected to be slightly older for all causes of death that were surveyed.

To summarize, both expert judgement studies performed during the GMI project were major factors in helping SCOR validate assumptions, while providing avenues to incorporate the perspectives of leading industry experts. In addition, the processes associated with the Delphi Study and the Medical Expert Judgement Study provided valuable insights and learnings that will be applied to future mortality improvement studies throughout SCOR.



Square Peg or Holy Grail?

For decades medical records, a.k.a. APSs, have been known as the gold standard for life insurance underwriting data, though the acquisition of medical records remains largely an inefficient paper process. Since the introduction of electronic health records (EHR) in the health field, life insurance labeled them the Holy Grail and vendors of this data as potential disruptors.

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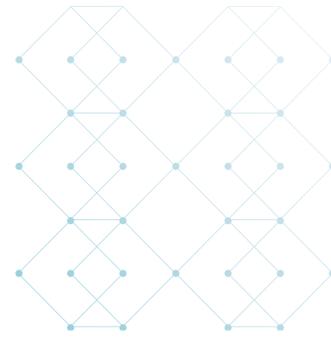


EHRs, which capture health information on individuals in an electronic format using diagnostic codes, do have the potential to disrupt life insurance underwriting. Used in combination with lab-free and automated underwriting programs, EHRs can help companies realize the vision of issuing a large percentage of applications without manual review, drastically reducing application time and cost while improving the customer experience and policy placement rates. However, effectively operationalizing EHRs into existing processes is a relatively new journey that requires comprehensive program planning and design and stakeholder buy-in from across an organization.

An EHR underwriting solution involves multiple parties having to overcome multiple obstacles. We have a long way to go, but a growing number of life insurers and reinsurers are leveraging work being done outside the industry.

Carriers are piloting and assessing EHRs and EHR retrieval technology to complete protective value studies, cost benefit analysis and determine the complexity and effort required to implement EHRs in their underwriting process. They are evaluating the pros and cons of the various EHR data retrieval solutions available to determine best fit for their risk pool.

At SCOR, we use the term “EHR data aggregator” to represent companies that perform EHR retrieval and aggregation of medical records from multiple parties in the health care industry. These companies contract with several health care data sources including health plans or provider networks to facilitate the data collection for the insurance carrier.



Below are four categories of EHR data aggregators in the life insurance space, but these lines are getting cloudy given new entrants (i.e., Apple and Google initiatives):

Patient Portal Solutions: platforms that aggregate EHR data from multiple patient portals; it enables applicants to complete a search for their doctor/provider, log into each of their respective patient portals and provide electronic authorization to EHR data.

Health Information Exchanges (HIE): organizations that facilitate the exchange of health care information electronically across organizations within a region, community or hospital system. This is critical because systems must be able to exchange and present data in a way that can be understood by the user.

EHR Vendors: vendors that obtain EHR data for insurers from patient portals and provide electronic authorization. A carrier builds interface to connect directly to EHR Vendor and extract EHR.

Aggregator of EHR Vendors: platforms that enable acquisition of applicant-authorized EHR from contracted EHR vendors.

There are pros on cons to each approach. For carriers, the biggest concern around each appears to be EHR content, customer experience, hit rate and national footprint.

EHRs are a substantial collection of codified data which include physicians' notes, vitals, records of allergies, medications, surgical procedures, lab results, as well as social determinants of health and provide a longitudinal health record rather than at one point in time.

Market analysis, EHR study, and discussions with leaders in the life insurance and EHR Data aggregator space have provided insights into the gaps/hurdles and potential opportunities.

EHR Gaps and Hurdles

1 Limited accessibility: A national or even state-based data set does not exist; patient records are not easily available to providers and patients – and certainly not insurance carriers.

2 Low hit rates: Those working on these solutions are still growing their network of data contributors.

3 Incomplete information or limited percent of EHR records: The records may not include attachments (diagnostic tests), referral notes or work-ups from outside specialists. The lookback period may be limited or only include records after EHR system implementation.

4 Full EHRs not available in real-time: About 60-80% of EHR data is unstructured.

5 Patient-matching and data-matching not 100% accurate: The US does not have a universal patient ID, and no single access point; errors in data matching to patient files.

6 Other concerns: This includes issues around volume or redundancy of data, disparate formats and multiple authorizations.

Potential Opportunities for EHR Implementation

1 Records on demand

2 Potential for lower acquisition costs

3 Potential for improved throughput in automated underwriting

4 Potential for decreased review time

5 Digital data available for study/research and further build out into AI models

6 Longitudinal information can give considerably more insight into the health of an applicant

Square Peg or Holy Grail?

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Current State in Healthcare

While the health space is experiencing high levels of adoption (99 percent of hospitals and more than 60 percent of all office-based physicians)¹ the landscape continues to struggle with interoperability as each EHR vendor has developed proprietary software and platforms and primarily related to ambiguity in data format requirements.

Privately-funded exchanges and vendor coalitions have emerged to advance implementation of secure, interoperable nationwide or regional health information exchanges and to support multiple, independent health interoperability initiatives. Much work is still required by healthcare to make EHRs available and useful.

In a 2018 study by the Office of the National Coordinator for Health Information Technology (ONC)*, half of physicians surveyed said they were not satisfied with their access to patient data, noting lack of access to patients' clinical history can impede care coordination and result in increased costs. In some instances, sharing EHRs between providers is still being done via fax with an average time of nine days.

Barriers hindering scalability to nationwide, vendor-neutral interoperability today include:

1. The average person sees more than 18 providers in their lifetime
2. Each provider has their own EHR(s) and other clinical data sources; current interoperability approaches simply don't scale
3. Health data information is still very siloed. Data blocking by providers/networks²
4. Need to create tightly constrained standards for data sharing and patient matching

¹ 2016 ONC Report

² 2015 ONC Report

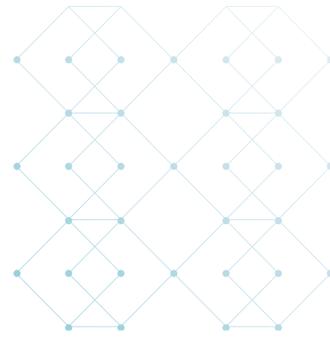
*ONC is organizationally located within the Office of the Secretary for the U.S. Department of Health and Human Services (HHS)

Proposed Regs Focus on Portability and Accessibility

EHRs still don't do the necessary job of making patient records easily available to providers and patients. They were originally designed as a tool to help with billing, and are falling short in their ability to provide data in a portable and accessible format. Earlier this year, the Centers for Medicare and Medicaid Services (CMS) and the ONC released proposed rules that focus on ensuring that health information is shared across the entire care continuum, including with patients. This is great news for healthcare, patients and life insurance underwriting. This increased focus/effort should result in access to more of the documents that underwriters need for risk assessment. Some of the top priorities included in the new rules are:

1. Solve interoperability so patients and providers can access medical records across health systems, practices and portals (intra-coordination vs inter-coordination)
2. Creation of national patient ID
3. EHR quality
4. Move from fragmented care to coordinated care

There are many favorable initiatives underway that could facilitate EHRs to earn the label of Holy Grail. The health industry is required to improve quality, quantity and access of EHR data, and the EHR data aggregators are focused on improving their national footprint and delivering quality formatted data.



EHRs for Underwriting and Research

The life industry is heavily relying on the EHR Data Aggregators to “figure it out”. With some guidance from carriers and reinsurers, the aggregators can attempt to provide a more comprehensive solution that has a national footprint and high hit rate. Such a solution will include needed medical information that is clean, formatted, easily consumable and can be utilized for risk assessment decisions by an underwriter or an automated system.

Given the low hit rates and limited networks of data contributors as well as EHR gaps/hurdles, it is likely that using EHR data alone would produce several instances where either no data is found, or where the data captured is incomplete.

The efforts involved in using EHRs is substantial, but early adopters will benefit from use of the data in current underwriting and for research, which will inform model development and improvements. In addition, early adopters can assist EHR data aggregators in developing solutions and benefit from a tailored solution. The availability of healthcare information as a data stream is a critical advantage for insurers using rules-based decision engines for accelerated underwriting and data-driven decision making.

EHRs are certainly not a “square peg,” and SCOR wants to do its part to move the industry forward and make EHRs a more complete solution. We are exploring the EHR space, and these efforts led us to invest in Human API, a San Francisco-based company that enables consumers to share their health data with the people and organizations that help them manage their health. This partnership supports SCOR’s desire to accelerate the underwriting process through electronic health data and automated decision making.



The genesis of EHR occurred outside the life insurance industry. It began as a government supported initiative with financial support embedded in the Affordable Care Act. The original objective was to improve patient care and better manage cost reimbursement. There are more than 750 vendors supplying EHRs to health care providers. And today we see new and existing vendors focused on markets in life and disability insurance.

Broken Heart Syndrome

Takotsubo Syndrome (TTS) was originally described by Japanese authors in the 1990s. The name was derived from the Japanese word for octopus pot, due to the shape of the left ventricle (LV) at the end of systole, which resembles an octopus trap used by Japanese fishermen. It has been described under a remarkable number of different names in the literature including Broken Heart Syndrome, Stress Induced Cardiomyopathy and Apical Ballooning Syndrome.



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In contrast to other cardiomyopathies that are usually not transient in nature, TTS is characterized by a temporary wall motion abnormality of the LV, and shares common features with acute coronary syndrome (ACS) with similar symptoms at presentation, ECG abnormalities, elevated cardiac biomarkers as well as a comparable in-hospital mortality.

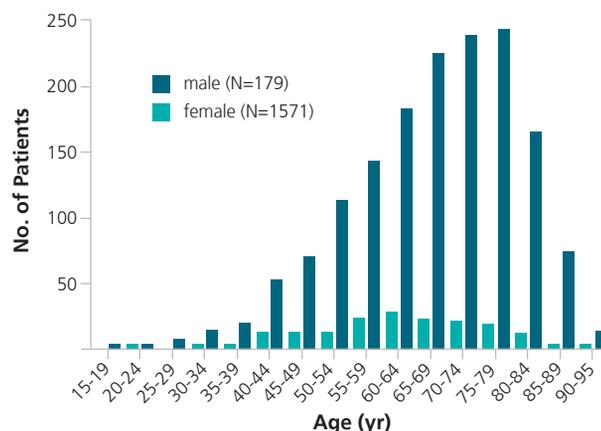
Epidemiology

Actually, 90% of cases involve women, most of whom are post-menopausal with mean age being 68 years.

Takotsubo syndrome is estimated to represent approximately 1–3% of all and 5–6% of female patients, presenting with suspected ST elevation myocardial infarction (heart attack).

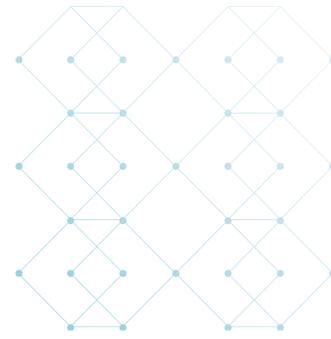
Women older than 55 years have a five-fold greater risk of developing TTS than women younger than 55 years and a 10-fold greater risk than men.

FIGURE 1: AGE AND SEX DISTRIBUTION OF PATIENTS WITH TTS



Source: C.Templin et al N Engl J Med 2015;373:929–938

90% of cases involve women, most of whom are post-menopausal.



Mechanisms

A hallmark of TTS is its association with a preceding stressful event. Physical triggers are more common than emotional stress factors retrieved respectively in 35 % and 30% of cases. Interestingly, male patients are more often affected from a physical stressful event, while in women an emotional trigger can be more frequently observed.

Recognition that TTS may occur spontaneously in 30% of cases has demonstrated the inappropriateness of the term 'stress cardiomyopathy' to describe the entire spectrum of TTS.

Psychological triggers represent a range of traumatic emotions including grief (death of a family member, friend, or pet), interpersonal conflicts (divorce or family estrangement), etc. Natural disasters such as earthquakes and floods are also associated with an increase in TTS events.

However, emotional triggers are not always negative, as positive emotional events can also provoke TTS (e.g., surprise birthday party, winning a jackpot and positive job interview). This is called "Happy Heart Syndrome".

The most recent evidence supports the concept that in the acute phase of TTS there is an increased concentration of circulating catecholamines (several times higher than in myocardial infarction). Acute emotional stressors have been shown to induce brain activation, increasing bioavailability of cortisol, epinephrine, and norepinephrine.

Mechanisms by which this surge of catecholamines impact the heart are not completely understood and different explanations are discussed such as multivessel coronary spasm, microvascular impairment, direct catecholamines toxicity, estrogens deficiency and endothelial dysfunction.

Broken Heart Syndrome

Emotional Triggers

- Depression
- Illness of a close person
- Suicide attempt
- Divorce
- Post-traumatic stress disorder

- Fear of speech
- Robbery / burglary
- Fear of surgery / hospitalization
- Move to another city

- New job
- Job loss
- Retirement

- Debt
- Huge loss of money
- Bankruptcy

- Death of a family member
- Death of a partner
- Euthanasia of a pet

- Argument with partner / family
- Argument with landlord

- Flooding
- Earthquake
- Storm
- Aircraft noise

- Car accident without injury
- Fall without fracture

Physical Triggers

- Cerebral bleeding
- Stroke / TIA
- Epilepsy, seizure
- Migraine
- PRES
- Concussion
- Aneurysm rupture

- Exacerbation COPD
- Asthma attack
- Pneumonia
- Bronchitis
- Pulmonary embolism
- Larynx spasm

- Gastrointestinal bleeding
- Crohn's disease exacerbation
- Hernia exacerbation

- Pheochromocytoma
- Urosepsis
- Urolithiasis

- Giving birth
- Vaginal bleeding

- Cancer
- Chemotherapy

- Influenza
- Sepsis
- Peritonitis
- Wound infection

- Fracture

Happy Heart Syndrome

Emotional Triggers

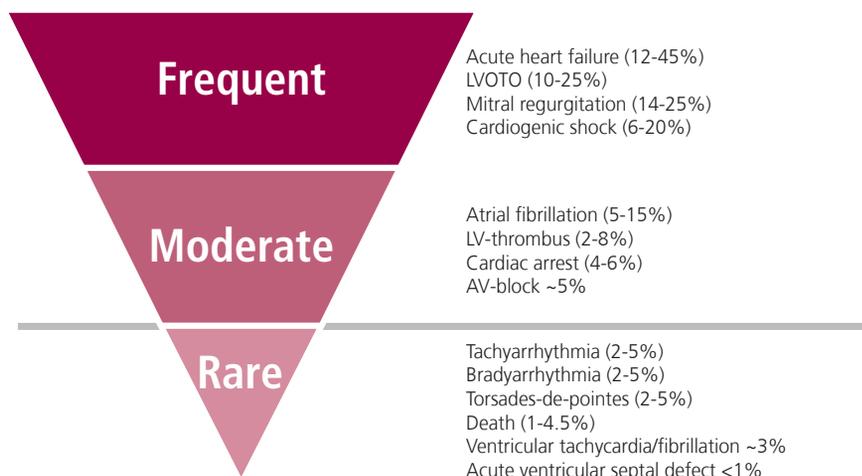
- Winning a jackpot
- Birthday party
- Birth of grandchild
- Wedding
- Visiting the opera
- Positive job interview

Physical Triggers

- Operation
- Anesthesia
- Administration of catecholamines

Broken Heart Syndrome

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Source: JR Ghadri et al *European Heart Journal* (2018) 39, 2047–2062

Diagnosis

TTS generally presents as an acute myocardial infarction characterized by severe left ventricular dysfunction.

To assess the diagnosis, the Mayo Clinic Diagnostic Criteria are the most widely known but they exclude an obstructive coronary disease and pheochromocytoma.

Nonetheless, concomitant Coronary Artery Disease is reported with a prevalence ranging from 10–30%, and pheochromocytoma is considered a TTS-like myocardial dysfunction by Japanese authors; that's why new international diagnostic criteria (InterTAK Diagnostic Criteria) have been developed and may help to improve identification and stratification of TTS:

- Patients show transient left ventricular dysfunction (hypokinesia, akinesia or dyskinesia) presenting as apical ballooning or midventricular, basal or focal wall motion abnormalities. Right ventricular involvement can be present.
- An emotional, physical or combined trigger can precede the takotsubo syndrome event, but this is not required.
- Neurologic disorders (e.g., subarachnoid hemorrhage, stroke/transient ischemic attack or seizures) as well as pheochromocytoma may serve as triggers for TTS.
- New ECG abnormalities are present (ST-segment elevation, ST-segment depression, T-wave inversion and QTc prolongation)
- Levels of cardiac biomarkers (troponin and creatine kinase) are moderately elevated in most cases; significant elevation of BNP is common.
- Significant coronary artery disease is not a contradiction in TTS.
- Patients have no evidence of infectious myocarditis.
- Postmenopausal women are predominantly affected.

During the acute phase, in the majority of cases, wall motion abnormalities typically involve the apical and midventricular segments, which appear akinetic or dyskinetic (defined as “apical ballooning”) in contrast to the basal segments, which are often hyperkinetic.

Apical ballooning is often associated with other suggestive features, such as Left Ventricular Outflow Tract Obstruction due to basal hypercontractility, and Mitral Regurgitation due to systolic anterior movement of the anterior leaflet of the mitral valve.

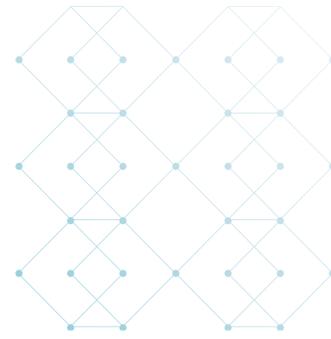
In the acute phase, LV ejection fraction is reduced and recovers with resolution of myocardial stunning.

The magnitude of myocardial dysfunction is wide and irrespective of single coronary artery territory distribution, while the degree of biomarker release (troponin) is quite small in proportion to the extent of Wall Motion Abnormalities, in contrast with the situation in acute MI.

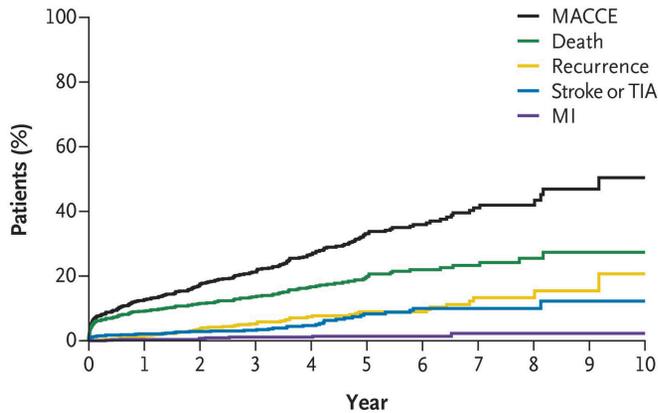
Complications of TTS

While TTS is usually a reversible condition, hemodynamic and electrical instability during the acute phase expose patients to the risk of serious adverse in-hospital events which occur in approximately one-fifth of TTS patients.

A multivariate analysis of the data from the International TTS registry, revealed that older age and the presence of emotional triggers independently predicted a lower incidence of the combined end point.

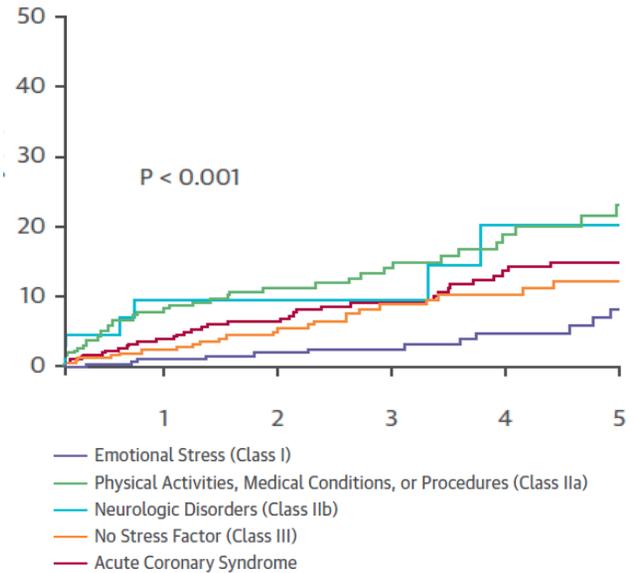


LONG-TERM OUTCOME OF PATIENTS WITH TTS



Source: Templin C et al N Engl J Med 2015;373:929-938

LONG-TERM MORTALITY OF TRIGGERING GROUPS



Source: Ghadri, J.R. et al. J Am Coll Cardiol. 2018;72(8):874-82

In contrast, the presence of physical triggers, acute neurologic or psychiatric disease, a first troponin measurement of more than 10 times the upper limit of the normal level, and a left ventricular ejection fraction of less than 45% each predicted a higher incidence of adverse in-hospital outcome.

Long term outcome

According to the InterTAK Registry report, which represents a consortium of 26 cardiovascular centers from Europe and the United States, thus the largest TTS registry to date, death rates are estimated to be 5.6%. The rate of major adverse cerebrovascular and cardiac events is 9.9% per-patient year. This suggests that TTS is not a benign disease with a 10 year mortality of 20 to 25%.

Although it is reasonable to expect TTS mortality to be related to primary LV pump failure, TTS events are frequently preceded by acute medical or surgical illnesses, which independently have poor prognosis. In this regard, mortality in TTS is likely related to both the magnitude of myocardial injury, the nature of the triggering event and comorbidities.

Overall, TTS patients had a similar long-term outcome compared with age- and sex-matched Acute Coronary Syndrome patients. TTS patients with events-related to emotional stress had a favorable short- and long-term prognosis. TTS secondary to neurologic diseases had the worst short-term prognosis.

TTS secondary to neurologic diseases and TTS secondary to physical activities, medical conditions, or procedures had significantly higher mortality rates compared with ACS during long-term follow-up.

References:

- Ghadri JR et al European Heart Journal (2018) 39,2032-2046
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- Templin C et al European Heart Journal (2019) 00,1-5

Industry Activities

As a leading life reinsurer in the Americas, our employees will be sharing their expertise in a number of industry presentations during the next few months.

AAIM
April 17
Dr. Richard Braun
Cervical Cancer

AHOU
April 30
Dr. Bill Rooney
Lynch Syndrome, Colon
Cancer & Colon Polyps

Rocky Mountain HOU
May 8
Dr. Bill Rooney
Genetics Basics for Underwriters

SOA Life & Annuity Symposium
May 20-21
Colleen Murray
Life Mortality Trends

Dr. Richard Braun
Unusual Presentations of
Alcohol Abuse

AQTV
May 9
Nathalie Racco
Liquid Biopsy

Katherine McLaughlin
Emerging Data Sources

Kristin Ringland
Chief Underwriters Panel

Brock Robbins
Inforce Policyholder Behavior

Ed Sheehan
Financial Underwriting
High Net Worth Individuals



Our most recent webinars are listed below. You will find links to the webinar recordings on the SCORcast page of our website <http://www.scorglobalifeamericas.com/en-us/knowledgecenter/Pages/ScorCast.aspx>

**Michael Colannino and
Dr. Michael Doney (HLI)**
Engage Your Inforce with
Health Assessment Services

Dr. James Kadouch
Broken Heart Syndrome

Dr. Richard Braun
Alcohol Use Disorder

Dr. Bill Rooney
HIV in 2018



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