Food for thought

Laughter and MIRTH (Methodical Investigation of Risibility, Therapeutic and Harmful): narrative synthesis

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OBJECTIVE
To review the beneficial and harmful effects of laughter.

DESIGN
Narrative synthesis.

DATA SOURCES AND REVIEW METHODS
We searched Medline (1946 to June 2013) and Embase (1974 to June 2013) for reports of benefits or harms from laughter in humans, and counted the number of papers in each category.

RESULTS
Benefits of laughter include reduced anger, anxiety, depression, and stress; reduced tension (psychological and cardiovascular); increased pain threshold; reduced risk of myocardial infarction (presumably requiring hearty laughter); improved lung function; increased energy expenditure; and reduced blood glucose concentration. However, laughter is no joke—dangers include syncope, cardiac and oesophageal rupture, and protrusion of abdominal hernias (from side splitting laughter or laughing fit to burst), asthma attacks, interlobular emphysema, cataplexy, headaches, jaw dislocation, and stress incontinence (from laughing like a drain). Infectious laughter can disseminate real infection, which is potentially preventable by laughing up your sleeve. As a side effect of our search for side effects, we also list pathological causes of laughter, among them epilepsy (gelastic seizures), cerebral tumours, Angelman's syndrome, strokes, multiple sclerosis, and amyotrophic lateral sclerosis or motor neuron disease.

CONCLUSIONS
Laughter is not purely beneficial. The harms it can cause are immediate and dose related, the risks being highest for Homeric (uncontrollable) laughter. The benefit-harm balance is probably favourable. It remains to be seen whether sick jokes make you ill or jokes in bad taste cause dysgeusia, and whether our views on comedians stand up to further scrutiny.

Introduction

The *BMJ* has not dealt seriously with laughter since 1899, when an editorialist, following an Italian correspondent's suggestion that telling jokes could treat bronchitis, proposed the term "gelototherapy" (in Greek gelōs means laughter; in Italian gelato means ice cream).[1] The journal had, a year before, described heart failure following prolonged laughter in a 13 year old girl.[2]

Fig 1 | You're having a laugh, doc. Duchenne demonstrates the facial muscles activated in mirthful laughter

Methods

We searched Medline from 1946 to June 2013 and Embase from 1974 to June 2013, using the search term "laugh$.mp", removing animal studies and conference reports, and excluding papers on the Caribbean sponge *Prosuberites laughlini* and with authors called Laughing,[3] Laughter,[4] Laughton, or McLaughlin; none was particularly amusing. We discarded papers with opaque titles, such as "Gelotophobia and thinking styles in Sternberg's theory",[5] and publications that proved irrelevant, such as "Another exciting use for the cantaloupe"[6] (which described practising endoscopy on melons). We identified three classes of findings: benefits from laughter, harms from laughter, and conditions causing pathological laughter. We discussed the uncertain cases.

Benefits

Dr Patch Adams advocated therapeutic clowning, declaring that "I have done vast numbers of clowning experiments . . . and have found friendliness and celebrating life to be the heavy artillery of the love strategy."[7] However, the benefits of laughter have often been assumed rather than demonstrated.

We concentrated on mirthful or "unintentional" laughter, also called Duchenne laughter, since he first demonstrated that genuine laughter is characterised by contraction of the zygomatic and the orbicularis oculi muscles (fig 1).[8]

Psychological and psychiatric benefits

Life satisfaction and laughter have been associated with one another,[9] but reciprocal causality has not been confirmed. Laughter can increase pain thresholds,[10] although hospital clowns had no discernible effect on distress in children undergoing minor surgery.[11] Perhaps surgical patients derive no advantage from being in stitches.

The presumed positive effects of laughter on wellbeing have been harnessed in serious mental disorders, without much evidence of benefit.[12-14]

Some psychoanalysts believe that a joke can substitute for interpretation—provided that the patient appreciates the joke. Others, however, view jokes as undesirable, because they circumvent resistance to psychic exposure and may be regarded as seductive.[15] Ken Dodd pertinently observed that Freud, who thought that laughter conserved psychic energy, never played second house Friday night at the Glasgow Empire.

Cardiovascular benefits

Laughter reduces arterial wall stiffness[16] and improves endothelial function.[17] So perhaps it relieves more than one kind of tension. Laughing lowers your risk of myocardial infarction,[18] and reduces recurrence after myocardial infarction in diabetes.[19] So, reading the Christmas *BMJ* could add years to your life.

Respiratory benefits

Laughter induced by a clown improved lung function in patients with chronic obstructive pulmonary disease.[20] One of the study's authors was a clown, something only alleged of other studies.

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bmj.com/video
Celebrity medical advice from Vinnie Jones

Comedian Ken Dodd "observed that Freud, who thought that laughter conserved psychic energy, never played second house Friday night at the Glasgow Empire"

CHRIS JACKSON/GETTY IMAGES

Metabolic benefits

In healthy people, "genuine laughter" for 15 minutes increased energy expenditure by up to 167.2 kJ (40 kcal).[21] Laughter induced by a comedy show attenuated the postprandial increase in glucose in diabetes by 2.5 mmol/L compared with a "monotonous lecture."[22] A day of merriment could therefore consume over 8360 kJ (2000 kcal), improve glycaemic control, and cure obesity.

Obstetric benefits

A clown, dressed as a chef de cuisine, entertained would-be mothers for 12-15 minutes after in vitro fertilisation and embryo transfer. His saucy jokes were a recipe for success— the pregnancy rate was 36% in those whom he entertained compared with 20% in the controls (adjusted odds ratio 2.67; 95% confidence interval 1.36 to 5.24).[25]

Otorhinolaryngological benefits

Sometimes life imitates art: "A surgeon proceeded to read [to me] the diverting history of 'The Lady Rohesia' [from *The Ingoldsby Legends*], and how she was cured of her quinsy . . . The story caused me to laugh, and this led to the bursting of the [tonsillar] abscess, and to my cure without the use of cold steel."[26]

Harms

Psychological harms

Humour weakens resolve and promotes brand preference,[30] so the prudent response to the drug rep's spiel would be "Don't make me laugh."

Cardiovascular harms

Hearty laughter can cause syncope,[31-35] perhaps by a neural reflex response to the increase in intrathoracic pressure that accompanies intense laughter.[36 37] Syncope after laughing has accompanied bilateral carotid stenosis in Takayasu arteritis.[38] Laughing can cause conduction anomalies[39] and arrhythmias.[40] A woman with long QT syndrome and a history of torsade de pointes took ziprasidone, collapsed, and died after intense sustained laughter.[41] Laughter in Angelman's ("happy puppet") syndrome can cause asystolic arrest, apparently of vagal origin.[42] Laughing fit to burst can cause cardiac rupture.[43]

Respiratory harms

The quick intake of breath that accompanies laugher can provoke inhalation of foreign bodies.[44]

Laughter sometimes triggers an asthma attack,[45] but cough after laughing is commoner than a good wheeze.[46 47] Asthma was once perceived as a psychological disorder,[48] but Gillespie noted that laughter probably had a physical rather than a psychological effect, and that even hollow (non-Duchenne) laughter could trigger an asthma attack.[49]

Laughter can cause pneumothorax.[50 51] Pilgaard-Dahl syndrome, named after two Danish revue actors, is pneumothorax in middle aged smokers induced by laughter.[52] If the YouTube video we have watched[53] is representative, non-Danish speakers are not at risk.

Interlobular emphysema can reportedly result from "efforts of parturition and of defaecation, by the lifting of heavy weights, during coitus, by paroxysms of rage, excessive laughter, and hysterical convulsions."[54]

Exhaled airflow—from sneezing, whistling, and laughing, for instance—potentially disseminates infection. Paper tissues may reduce spread.[55] So, we suspect, might laughing up your sleeve.

Central nervous system harms

Cataplexy, often allied to narcolepsy (Gélineau's syndrome),[56] is characterised by sudden loss of muscle tone provoked by laughter and other stimuli.[57] It is apparently difficult to elicit during medical consultations,[58] perhaps because "laughing by itself" is a much less powerful stimulus than "laughing excitedly."[59] The combination of muscle weakness induced by laughter and the ability to hear during an episode distinguishes cataplexy from sleep apnoea.[60] In one case, cataplexy induced by laughter affected only the right side of the body;[61] this patient presumably could still laugh on the other side of her face.

Laughter, like many pleasurable things, including ice cream, chocolate, and sex (separately, and perhaps together), may precipitate headaches.[62] The Chiari malformation and colloid cysts of the third ventricle are occasionally associated with laughter induced headache.[63 64]

A woman with a patent foramen ovale laughed uproariously for three minutes, became aphasic, and had a cerebral infarct.[65]

Gastrointestinal harms

A good belly laugh can make a hernia protrude, aiding diagnosis in children[66]—rapture unmasking rupture. By contrast, failure to laugh is a sign of intra-abdominal infection in children.[67] Laughter is an unusual precipitant of Boerhaave's syndrome, spontaneous oesophageal perforation.[68]

Musculoskeletal harms

Laughing can dislocate the jaw.[69] Rectus sheath haematoma is described as an adverse reaction to side splitting "laughter therapy."[70]

Urinary tract harms

Laughing like a drain can cause stress incontinence.[71] It can also cause "enuresis risoria" ("giggle micturition" or "giggle incontinence"),[72 73] a consequence of uncontrolled detrusor contraction induced by laughing.[74]

Pathological causes of laughter

Laughter has its serious side. We have identified many disorders associated with unprovoked laughter – for example, gelastic seizures. (See web table).

Limitations of the study

We limited our search to "laugh$," and did not seek cacchinations, cackles, chortles, chuckles, giggles, grins, guffaws, smiles, smirks, sneers, sniggers, teehees, or titters; we also ignored sources of laughter (comedy, drollery, humour, jest, jocularity, whimsy, wit, and wisecracks).

Embase and Medline do not yet index some potential sources of information, including *HUMOR: International Journal of Humor Research*, *Therapeutic Humor*, *Cahiers de recherche de CORHUM-CRIH*, the *European Journal of Humour Research*, and the *Israeli Journal of Humor Research* (yet).[75]

We categorised effects as beneficial or harmful, a usually clear-cut distinction; some effects, however, such as lowering the threshold for seduction, could not be unequivocally categorised.

Some readers may ignore the benefits of laughter—that would be serious; others may dismiss its harms—we call them the laughing cavalier.

Discussion

Our review refutes the proposition that laughter can only be beneficial. However, invoking a pharmacological classification,[76] the harms occur during prolonged overdose (toxic effects), occur immediately after exposure, and are most dangerous in those with susceptibility factors. We infer that laughter in any form carries a low risk of harm and may be beneficial.

These conclusions are necessarily tentative. It remains to be seen whether, for example, sick jokes make you ill, if dry wit causes dehydration, or jokes in bad taste cause dysgeusia, and whether our views on comedians stand up to further scrutiny.

Full details including references and competing interests are in the version on bmj.com.

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Following celebrities' medical advice: meta-narrative analysis

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OBJECTIVE
To synthesise what is known about how celebrities influence people's decisions on health.

DESIGN
Meta-narrative analysis of economics, marketing, psychology, and sociology literatures.

DATA SOURCES
Systematic searches of electronic databases: BusinessSource Complete (1886-), Communication & Mass Media Complete (1915-), Humanities Abstracts (1984-), ProQuest Political Science (1985-), PsycINFO (1806-), PubMed (1966-), and Sociology Abstracts (1952-).

INCLUSION CRITERIA
Studies discussing mechanisms of celebrities' influence on people in any context.

RESULTS
Economics literature shows that celebrity endorsements act as signals of credibility that differentiate products or ideas from competitors and can catalyse herd behaviour. Marketing studies show that celebrities transfer their desirable attributes to products and use their success to boost their perceived credibility. Psychology shows that people are classically conditioned to react positively to the advice of celebrities, experience cognitive dissonance if they do not, and are influenced by congruencies with their self conceptions. Sociology helps explain the spread of celebrity medical advice as a contagion that diffuses through social networks and people's desire to acquire celebrities' social capital.

CONCLUSIONS
The influence of celebrity status is a deeply rooted process that can be harnessed for good or abused for harm. A better understanding of celebrity can empower health professionals to take this phenomenon seriously and use patient encounters to educate the public about sources of health information and their trustworthiness. Public health authorities can use these insights to implement regulations and restrictions on celebrity endorsements and design counter marketing initiatives—perhaps even partnering with celebrities—to discredit bogus medical advice while promoting evidence based practices.

Parkinson's lore: "The test is if you can pee against a wall from two feet, you haven't got it"

Introduction

Celebrities frequently give medical advice and people often follow it. Whether motivated by good intentions or financial rewards, celebrities can generate much publicity for health campaigns by virtue of their visibility, public interest, and perceived newsworthiness. When journalist Katie Couric televised her colonoscopy on NBC's *Today Show* in 2000, colorectal cancer screenings by 400 American endoscopists increased by 21% the next month.[1] Following actor-singer Kylie Minogue's diagnosis of breast cancer, bookings for mammograms rose by 40% in four Australian states.[2] Twice as many screenings for cervical cancer were conducted in England during March 2009 compared with the same month one year earlier, corresponding to reality TV star Jade Goody's death from the disease.[3]

Many celebrities have mobilised their influence for good. Actor Michael J Fox's foundation has raised over $350m (£215m; €260m) for research into Parkinson's disease,[4] whereas singer Sir Elton John's charity has raised more than $300m towards research into HIV/AIDS.[5] But the messages espoused by celebrities can also conflict with those recommended by health professionals, public health authorities, and the best available research evidence. British television presenter Sir Michael Parkinson promoted an unsupported self diagnosis technique for prostate cancer based on his own experiences: "The test is if you can pee against a wall from two feet, you haven't got it."[6] Having breast cancer at age 36, actor Christina Applegate promoted magnetic resonance imaging for early detection; yet the US National Cancer Institute does not endorse such investigations for those at average risk of breast cancer.[7] Actor Suzanne Somers advocates her own brand of medicine, including bioidentical hormones to reverse aging and proteolytic enzyme therapy for pancreatic cancer, despite her therapies lacking evidence of effectiveness.[8 9]

People are trusting celebrities with their health. While celebrities sometimes encourage healthy behaviours of proven benefit, at other times they spread misinformation and harmful practices. The potential years of life lost and wasted healthcare dollars from all the useless products and bogus treatments that celebrities sometimes promote at the expense of evidence based practices, make this phenomenon a critical challenge worthy of serious address.

In this meta-narrative analysis we synthesised insights from systematic searches of the economics, marketing, psychology, and sociology literatures, and additional targeted searches, to explain how celebrities gain credibility as medical advisers and how the public falls under their influence when making important decisions about health.

Methods

We searched the electronic databases BusinessSource Complete (1886-), Communication & Mass Media Complete (1915-), Humanities Abstracts (1984-), ProQuest Political Science (1985-), PsycINFO (1806-), PubMed (1966-), and Sociology Abstracts (1952-). (For full details see bmj.com.)

Results

Our searches of the economics, marketing, psychology, and sociology literatures revealed multiple narratives about the mechanisms through which celebrities may influence people's health decisions (box). The most compelling narratives are presented below.

Narratives from economics

Celebrity endorsements as signals—When celebrities endorse a product or idea, they differentiate it from others. According to signalling theory, signals are markers that convey key information

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about an object or individual and aid decisions.[10] Consumers of health information may find decision making difficult when health professionals, friends, family, and online resources contradict each other. To help in this task, people naturally look for signals that indicate one source as being more credible and effective than another.[10] Owing to the vaulted status of celebrities in society, their endorsements act as signals of superiority that distinguish the endorsed item from competitors, encouraging people to change their health behaviours accordingly.

Celebrities leading the herd—Celebrities are often early leaders of herd behaviours, whereby people naturally tend to make decisions based on what others have done in similar situations.[11 12] Wanting to follow in their favourite celebrities' footsteps, many will ignore their personal information and imitate the celebrity health choices they observe.[11] This behaviour initiates an informational cascade: the celebrity's decisions are passed to others, who make the same choices.[12] As the number of followers increases, the herding effect lengthens and strengthens, spreading from person to person and changing health behaviours along the way.[12] For instance, actor Angelina Jolie's preventive double mastectomy after testing positive for the BRCA1 gene mutation led to a heightened interest in genetic testing.[13] However, since BRCA mutations are rare, testing is only recommended for women with a high risk or family history of breast cancer.[14] Jolie's announcement may have catalysed a herd seeking the test, including many for whom it is neither appropriate nor cost effective.

Narratives from marketing

Meaning transfer from celebrities to consumers—Celebrities may be successful medical advisers because consumers see in them attributes they respect and want to emulate. This desire stems from a process marketing researchers call meaning transfer. For many people, celebrities represent important social or cultural meanings that become associated with ideas or products they endorse.[15] People in turn consume endorsed items in hopes of acquiring these traits.[16] Tobacco companies are infamous for using celebrities to sell their products. Through fostering close relations with movie studios and prominently featuring stars in advertisements,[17 18] companies transfer the attractive and sophisticated image of celebrities to their cigarettes. The strategy works: smoking in movies has been found to alter perceptions of and susceptibilities towards smoking among adolescents.[19 20]


Cancer tests go up after Goody diagnosis

Halo effect—Celebrity credibility significantly influences an endorsement's effectiveness.[21 22] In acting as medical advisers, many celebrities often have, or portray themselves to have, an authentic connection to the promoted behaviour or product.[23] Even celebrities without a genuine connection have been perceived as credible. This credibility may stem from the halo effect of celebrities' success, which biases people's judgments of celebrities' other traits and gives them a cloak of generalised trustworthiness that extends well beyond their industry or expertise.[24] Celebrities are in turn perceived to have greater credibility than their non-celebrity counterparts, such as doctors, despite having less medical knowledge and experience.

Narratives from psychology

Classical conditioning—The psychological process of classical conditioning occurs when people learn to associate two stimuli such that exposure to either achieves similar responses.[25] Celebrity endorsed items come to elicit the positive responses many associate with their favourite celebrities. Eventually, the items elicit the same positive sentiments even without the celebrity.[25] One recent study found that coupling an attractive and trustworthy celebrity with a product led to significantly higher product ratings; stronger or more compatible pairings led to even greater conditioning and more positive attitudes.[25] Medical advice from celebrities may be conditioned to evoke consumers' positive perceptions of celebrities, an effect that is strengthened when the advice matches the celebrity's image.

Self conception and celebrity endorsers—Advice from celebrities may have greater impact on health behaviours when it matches people's self conception, which includes the thoughts and attitudes people have of their actual self, those they would like for their ideal self, and those they use to present their social self.[26] People often use images projected by celebrities to define their self conception, which makes celebrity advice highly influential.[27 28] For celebrities viewed as inspirational, their advice may be compatible with people's ideal self such that the self esteem motive—to elevate one's actual self towards one's ideal self[27]—pushes people to follow the advice. One study found that compatibility between a celebrity endorser's image and a person's ideal self was associated with higher advertisement ratings and greater purchase intention.[29] Conversely, for celebrities who portray themselves as similar to their admirers, their advice will be compatible with people's actual self such that the self consistency motive—to maintain one's actual self[27]—may be the motivating factor.

Someone like you

Cognitive dissonance—The desire to maintain mental consistency and avoid cognitive dissonance may account for why the medical advice of celebrities is followed. People experience psychological discomfort when their decisions, behaviours, knowledge, beliefs, or opinions conflict, which is something people naturally avoid.[30 31] For example, fans may experience dissonance if they ignore their favourite celebrity's medical advice, because this act conflicts with their adoration for the celebrity. However, following the advice can also create dissonance since endorsed behaviours may require substantial changes or investments. To reduce this dissonance, followers unconsciously modify their cognitions, such as internalising the belief that the celebrity's advice is more credible than alternatives.[32] They also adopt new beliefs or commit to actions that diminish inconsistencies, including seeking information supporting the celebrity advice.[32] People even trivialise dissonant cognitions to make the conflict seem less important, such as minimising the costs and harms of the advice.[32] In this way, people unconsciously justify following celebrities' medical advice while strengthening their attachments to the celebrity in the process.

Narratives from sociology

Celebrity advice spreads through social networks—The widespread uptake of celebrity medical advice can also be explained as a social contagion that diffuses through social networks, which are systems of people linked through personal connections.[33] One person's health decisions create externalities, by which connected people experience indirect consequences.[34] Observational studies have found these ties to have significant effects on people's health, including smoking,[35] obesity,[36] sexual activities,[37] and hap-

smoking,[35] obesity,[36] sexual activities,[37] and happiness.[38] Although celebrities' social ties to most people are weak, their newsworthiness and star quality—and the intense unidirectional interactions super fans have with them, known as parasocial relationships—allow them to feature prominently within social networks and achieve great influence as medical advisers to the masses.

Commoditising celebrity and acquiring social capital—Celebrity has become commoditised in contemporary society as something that can be bought and sold.[39] People "purchase" celebrity by acquiring celebrities' products, mimicking their lifestyles, and heeding their medical advice. These parasocial relationships have been conceptualised as a means of acquiring celebrities' social capital: the benefits and resources accrued through social relationships.[40] For people seeking to raise their social status, one strategy is to imitate the behaviours of celebrities.[41] Celebrities and their coveted status, in this sense, have become resources in forming consumers' social identities, used to shape the ways people see themselves and want others to see them.[39] Following celebrity medical advice may be a method for consumers to gain social capital and participate in the practices that make celebrities "special," thereby elevating them in society.

Mechanisms by discipline explaining influence of celebrities

Economics

Signals—Endorsements by celebrities act as markers that differentiate endorsed items from those of competitors

Herd behaviour—Celebrities activate people's natural tendency to make decisions based on how others have acted in similar situations

Marketing

Meaning transfer—People consume endorsed items to acquire the endorsing celebrities' traits, which have become associated with the product

Halo effect—The specific success of celebrities is generalised to all their traits, biasing people to view them as credible medical advisers

Psychology

Classical conditioning—The positive responses people have towards celebrities come to be independently generated by endorsed items

Self conception—People follow advice from celebrities who match how they perceive (or want to perceive) themselves

Cognitive dissonance—People unconsciously rationalise following celebrity medical advice to reduce the psychological discomfort that may otherwise result from holding incompatible views

Sociology

Social networks—Celebrity advice reaches the masses by spreading through systems of people linked through personal connections

Social capital—People follow celebrity medical advice to gain social status and shape their social identities

Discussion

Celebrities have substantial sway as health advisers. There are strong biological, psychological, and social bases accounting for why people follow celebrities' medical advice. Celebrities can thereby be helpful or threaten the public's health. Their power can be harnessed to disseminate information based on the best available research evidence, or it can be abused to promote useless products and bogus treatments.

Health professionals can counter the negative influences of celebrities by speaking to their patients about the validity of celebrity advice and sources of reputable health information. Those times when patients mention the latest celebrity endorsement should be seen as a meaningful opportunity to start important educational conversations rather than as an annoyance. Doing so not only informs patients about the kinds of health behaviours that are truly beneficial, but also encourages them to place more trust in their trained health professionals.

The medical community can also improve its efforts to increase public understanding of health issues and to discredit the most egregious examples of celebrity advice. One method may be to enact restrictions on celebrity endorsements to ensure promoted messages are supported by research evidence. Requiring celebrities to disclose conflicts of interest, such as financial compensation, is one option. Another is to actually work with celebrities. By partnering with celebrities in productive ways to disseminate science and share basic critical appraisal skills, celebrities can be used as powerful tools for health literacy and health promotion. Public health authorities can take inspiration from previous partnerships that have leveraged the clout of celebrities for good. Chef Jamie Oliver collaborated with government officials and charities to make school meals healthier in the United Kingdom, an effort found to have had a lasting effect on students' educational performance.[42] Actor Glenn Close is a recognised advocate for mental illness.[43] Model Christy Turlington released a commercial with the US Centers for Disease Control and Prevention urging viewers to refrain from smoking.[44] Collaborations with celebrities can be further complemented by counter marketing and social media efforts to discredit incorrect messages from celebrities while spreading evidence based advice.

Ultimately, there is a need to fundamentally rethink and better understand where people obtain their health information and what makes them act on it. Understanding why people follow celebrities' medical advice and developing strategies to exploit the implicated biological, psychological, and social processes to promote evidence based practices represents a good start. Doing so may require fostering constructive relationships with celebrities, allowing them to become important partners in improving health.

Full details including references and competing interests are in the version on bmj.com.

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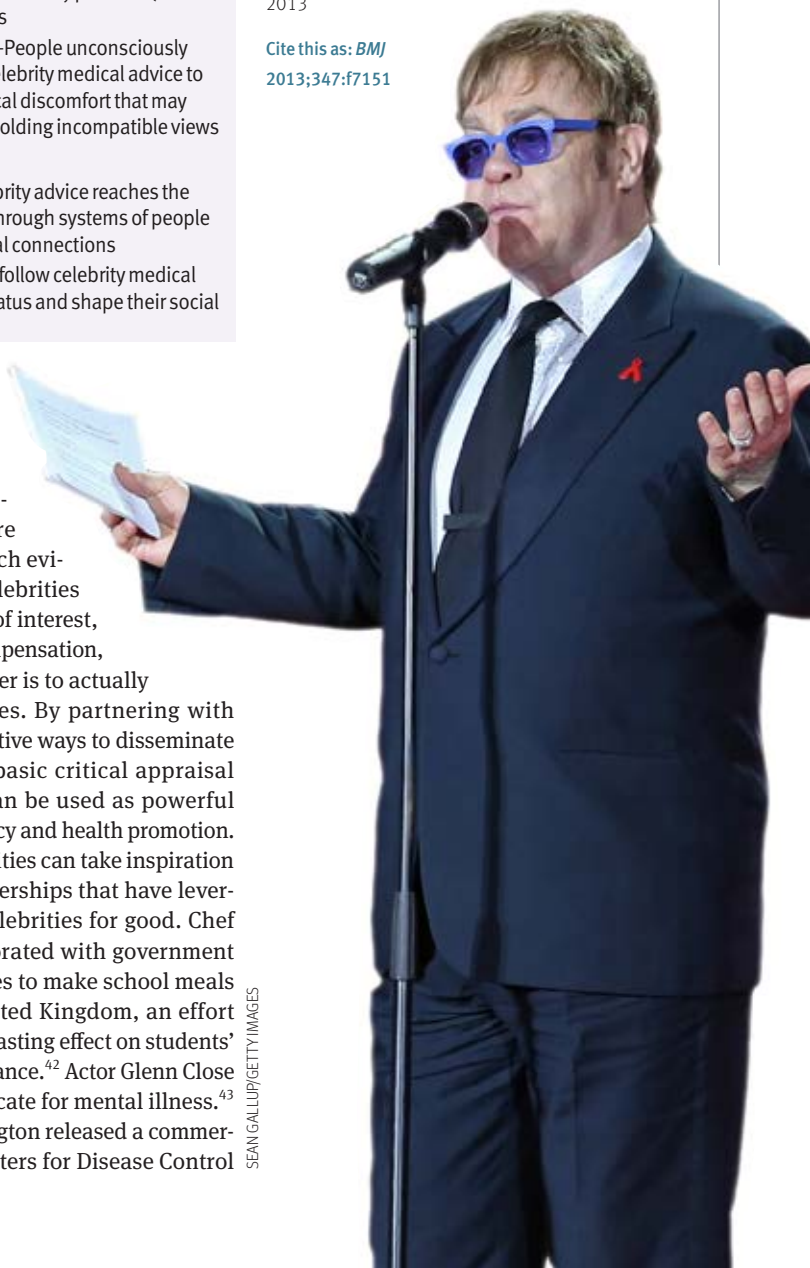


SEAN GALLUP/GETTY IMAGES

The cheeseberg: a unified model of patient safety

Patient safety gurus routinely reach for swiss cheese and icebergs when talking about medical error. What would combining these two metaphors look like, wonder **Enrico Coiera and colleagues**

Students of patient safety rely on a few foundational models to explain the iatrogenic causes of patient harm. Reason's classic Swiss cheese model[1] encapsulates the idea that although an organisation such as a hospital has many defences against error (the cheese), once in a while holes in the defences line up to allow an error through. Heinrich's iceberg model reminds us that while some harm events are reported (the tip), most remain unrecorded because they are relatively minor or do not lead to harm (perhaps because, to mix metaphors, a bit of cheese luckily got in the way).[2]

We propose a generalised model of patient safety that unifies these two foundational models to create a more expansive theory for patient safety. This unified theory, we contend, can better explain the nature of patient harm and our responses to it.

The building blocks

Let us begin with two building blocks—cheese and ice. Cheese is a metaphor for organisational defences and ice for safety incidents and their associated harms. Although these are useful simplifications, neither really captures the inherent sociotechnical complexity of healthcare. Clearly our organisations are neither all ice nor all cheese. We thus need a third hybrid building block—ice-cheese—to emphasise that clinical organisations can defend against harms but that nevertheless harms still do occur. Unlike apple-orange, ice-cheese is probably a continuum substrate, a bit like space-time.

Aside from their elemental "substance," these building blocks exhibit one of two basic properties. Reason's model uses holes to model pathways to harm. The iceberg emphasises being mainly under the water to represent the hidden nature of our experienced world.

A new family of safety models

We propose a combinatorial expansion of these building blocks (ice, cheese, ice-cheese) and their properties (presence of holes, being mainly under water). This expansion generates a rich, coherent, and unified family of new patient safety models (table). This family still includes our two "classic" models, but these are now joined by seven sister models. Several models in particular are powerful new additions to the patient safety conceptual toolbox.

The cheeseberg (aka the "Monterey Jack")

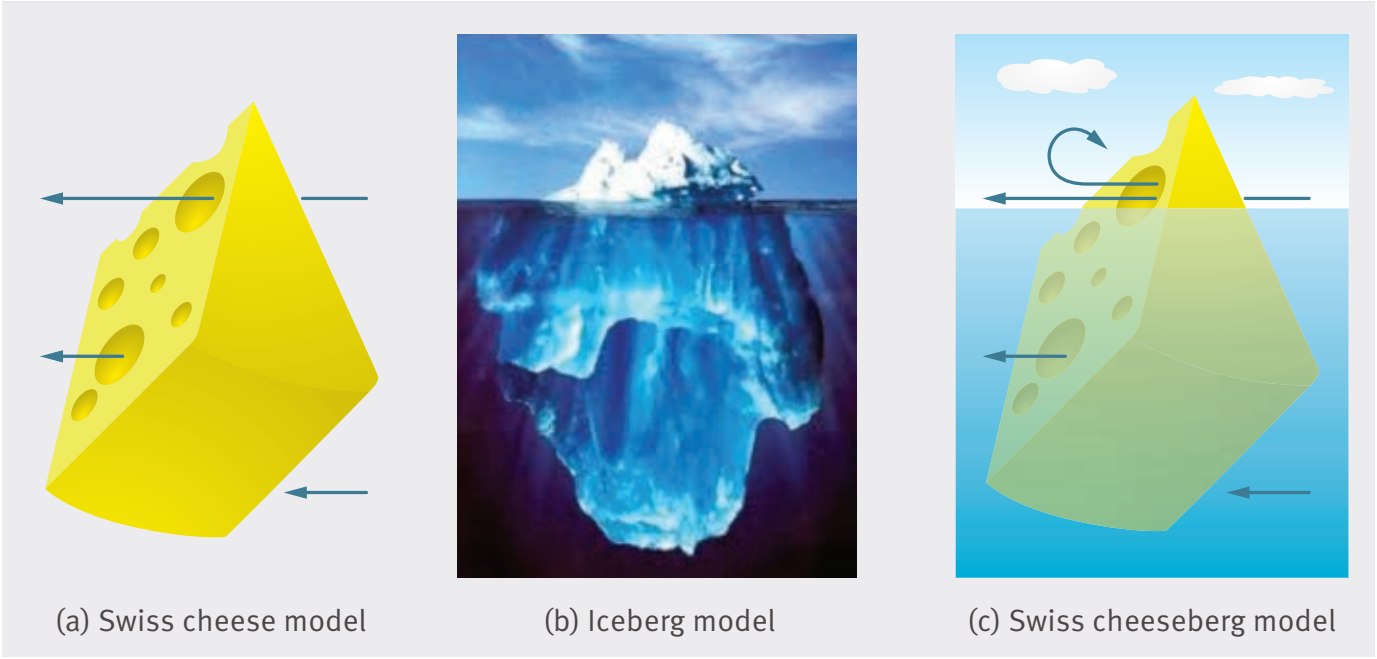
The cheeseberg model represents the goal end state for patient safety, when organisations have become error-free because their defences have no more holes. The model sits in stark counterpoint to that of the iceberg, which models organisations only as error, thus freeing bureaucrats to believe that all that is needed for harm reduction is to dunk a few clinicians in hot water. This mindset might be reset by envisioning healthcare becoming hole-free cheese, but this model too carries conceptual risk. The cheeseberg assumes that there are no more holes, but such a circumstance does not mean that we can relax safety practices. Rather, vigilance must continue because in any complex system, new holes may form at any time and often as the unintended consequences of otherwise perfectly sensible actions.

Swiss ice

The old Swiss cheese model showed how errors can, despite our best efforts, slip through. It said nothing about all the good that is done. The Swiss ice model reminds us that once in a while, despite all the errors in the system, good care sneaks through the holes. It celebrates the human instinct to dig deep, work around impasses, fight on, and find a way through. If the authors were British, this would be the sentence in which we invoke Dunkirk, but we are not.

The Swiss cheeseberg

A powerful union of our two classic models, the Swiss cheeseberg (figure), not only reminds us that errors occur despite organisational defences but also that we rarely detect them. The nature of



(a) Swiss cheese model (b) Iceberg model (c) Swiss cheeseberg model

Combining the classic Swiss cheese (a) and iceberg (b) models produces the Swiss cheeseberg (c)

Conceptual matrix of patient safety models, combining building blocks and their properties			
Building blocks	**Has holes**	**Mainly under water**	**Has holes and mainly under water**
Cheese (defences)	Swiss cheese	Cheeseberg	Swiss cheeseberg
Ice (errors and harms)	Swiss ice	Iceberg	Swiss iceberg
Ice-cheese	Swiss ice-cheese	Ice-cheeseberg	Swiss ice-cheeseberg

the cheese in this model is important. Research into patient safety suggests that to be resilient and adaptive, organisations should strive to model themselves after the softer cheeses. Hard cheeses such as Parmesan or Romano are rigid, inflexible, and brittle to change—a slip of the knife leads to permanent damage. Something like Camembert, goat, or cream cheese, however, offers consistency, flexibility, and opportunities for recovery. These cheeses can even remodel with warming to fill in some holes.

Furthermore, just as cheese may vary in its properties, so too can water. An organisation floating in a warm and supportive bath of Mediterranean waters will itself be warmer and more open to change, compared with one floating in the icy Antarctic waters of bureaucratic indifference. A warning, however—dropping organisations into waters agitated by the white heat of dramatic change inevitably results in a state technically known as "fondue."

The Swiss iceberg

In this model, organisations are still modelled as error-prone places; most of the good that sneaks through the holes sits unseen below the waterline. It is a model that will resonate with working clinicians everywhere. While government reviews and newspapers regularly report what is wrong with healthcare, they do not spend much time telling us what is right. Our efforts are hidden, unnoticed, and unrewarded. We feel left out in the cold.

The Swiss ice-cheeseberg

The Swiss ice-cheeseberg is the most comprehensive member of our new family of patient safety models, and because it comes "with the works," it is the one that most closely represents our world. It tells us that much of what happens in healthcare is hidden to us all, but that it remains a place where cheese is plentiful and good things do happen despite the ice.

If this was a dish on the menu, we suspect that there would be requests for mustard or ketchup as an accompaniment. We contend that although such additional layers might add some short lived tang to the enterprise, they do little to change the underlying meal. Condiments are not unlike the layers of organisational restructuring and other bold new reform programmes that are spread over healthcare organisations, rarely resulting in substantial change. Yet, despite the evidence, such restructuring is invariably triggered by a change in government.[3]

Conclusion

Patient safety is a serious concern, and the better that things can be seen as they really are, the better the chances of dealing with that reality.

A warning, however—dropping organisations into waters agitated by the white heat of dramatic change inevitably results in a state technically known as "fondue"

Models caricature the world to help make some sense of what we experience but can also make things too simple and give only the illusion of understanding.

It is in the nature of complex systems such as healthcare that the unexpected happens, and unpredictably so.[4] It is our hope that in future, when listening to a lecture or reading a manuscript that only models patient safety as Swiss cheese or an iceberg, that our minds might drift, recalling other configurations, such as the Swiss cheeseberg and indeed its extended family. They too have much to tell us.

Achieving patient safety is hard, and finding new ways to think about harm reduction requires the exploration of many different models.[5] All such models are wrong, we acknowledge. However, we humbly submit that the models presented here are at least as wrong as the ones on which they are based.

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Back to school anatomy: just add Plasticine

Anatomy teaching for junior doctors and surgical trainees can be uninspiring and monotonous. We tried a fun hands-on adjunct to anatomy teaching in relation to surgical approaches to the hip.

We asked participants to describe all the important structures (muscles, nerves, vessels) around the hip joint; name the origin, attachments, innervations, and function; and then to make the structures from Plasticine (figures).

Using a model of the bony pelvis and hip joint, participants then attached the structures to the relevant landmarks. One

person was selected to make an "incision" through all the layers encountered in a posterior approach to the hip.

In our experience, Plasticine models create an interactive learning experience that is relevant to surgical practice.

Participants felt that it improved their appreciation of three dimensional anatomical associations—in particular, the proximity of the sciatic nerve during the dissection. Another session on the foot was also well received.

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