

Course Guide for the Video Series
Science-Based Medicine by Harriet Hall, MD

Presented by The James Randi Educational Foundation

YouTube.Com/user/JamesRandiFoundation

This course consists of 10 lectures:

1. Science-Based Medicine vs. Evidence-Based Medicine
2. What Is CAM?
3. Chiropractic
4. Acupuncture
5. Homeopathy
6. Naturopathy and Herbal Medicine
7. Energy Medicine
8. Miscellaneous “Alternatives”
9. Pitfalls in Research
10. Science-Based Medicine in the Media and Politics

Why spend so much time on CAM?

1. Explaining what good science ISN'T is the best way to understand what it IS.
2. Much of CAM falsely claims to be based on good scientific evidence, and we need to understand why SBM rejects those claims.

This work is licensed under the Creative Commons Attribution 4.0 International License.

Lecture 1: Science-Based Medicine vs. Evidence-Based Medicine

Science is a recent development.

- Evolution shaped our brains to survive as hunter-gatherers; our thinking is “intelligently illogical.”
- We are so good at pattern recognition that we see patterns that are not real.
- We tend to jump to conclusions.
- We prefer to get information from stories than from studies: we are unduly impressed by anecdotes.
- Science is a way of correcting for human misperceptions and cognitive errors, and scientific thinking doesn’t come naturally.
-

How can we know if a medical treatment works?

- Unsystematic observation of apparent cures is often misleading.
 - Bloodletting fooled doctors and patients for centuries
 - Surgery that was believed to work for heart disease proved to be no better than sham surgery.
 - The three most dangerous words in medicine: “In my experience.”
- There are many reasons we come to believe ineffective treatments work:
 1. The disease may have run its natural course.
 2. Many diseases are cyclical.
 3. We are all suggestible.
 4. The wrong treatment may get the credit.
 5. Diagnosis and prognosis may be wrong.
 6. Temporary mood improvement confused with cure
 7. Psychological needs affect behavior and perceptions
 8. We confuse correlation with causation
- The scientific method corrects for errors in thinking.
 - Medicine’s Beautiful Idea: every treatment must be tested.
 - James Lind’s experiment with scurvy in 1747: first modern clinical trial

Evidence-based medicine was a good idea that failed to live up to its promise.

- The EBM hierarchy identifies the lowest level of evidence as in vitro studies, followed by animal research, editorials and opinions, case reports, case series, case control studies, cohort studies, and the highest level: “gold standard” randomized controlled double blind studies and systematic reviews.
- Something is missing: evidence from basic science
 - It can indicate that a treatment is highly improbable or impossible.
 - Carl Sagan: extraordinary claims require extraordinary evidence.
 - EBM ignores plausibility and gives equal weight to RCTs of impossible things like homeopathy.

- EBM has worked well for conventional medical treatments, but it hasn't worked well for things outside the scientific paradigm or for implausible treatments.
- A group of us began to use the term "Science-Based Medicine" and established a blog by that name in January of 2008. SBM is what EBM should have been.
 - Definition of SBM: Evaluates health claims, practices, and products using the best scientific evidence available, in the light of our cumulative scientific knowledge from all relevant disciplines.
 - Science:
 - A method of inquiry, a disciplined process for testing hypotheses
 - Reaches provisional conclusions based on the best available evidence
 - Changes those provisional conclusions when the evidence changes
 - Sometimes makes mistakes but is self-correcting through peer review and expert consensus.
 - Gives us knowledge we can use to make accurate predictions.
 - Is far more reliable than any "other ways of knowing."
 - Is universal (there's no such thing as "Western science.")

Lecture 2: What is CAM?

Lecture 1 was about what science-based medicine *is*; this lecture is about what it *isn't*. CAM stands for complementary and alternative medicine.

CAM was once defined as “stuff that isn’t taught in medical schools.”

- Everything from homeopathy to acupuncture, from ear candles to urine therapy, from herbal medicine to aromatherapy.
- Today, some of those things are sneaking into our medical schools

Terminology changed from quackery, folk remedies, etc. to:

- “Alternative medicine” in the 1960s and 70s, then to “complementary medicine” in the 1990s, then to “complementary and alternative medicine,” and finally to “integrative” medicine.
- CAM is “a marketing term created to promote a diverse set of dubious, untested, or fraudulent health practices.”

CAM is a shortcut from idea to bedside, bypassing good science.

- No-one believes in all CAM treatments; they contradict each other.
- There are at least 67 different ideas about “the one true cause of all disease.”
- Science recognizes a lot of different causes organized under the mnemonic “VINDICATE”
 - V – Vascular
 - I – Infectious/inflammatory
 - N – Neoplastic
 - D – Drugs/toxins
 - I – Intervention/iatrogenic
 - C – Congenital/developmental
 - A – Autoimmune
 - T – Trauma
 - E – Endocrine/metabolic

The 1980s and 90s saw a resurgence of old treatment methods that had almost disappeared.

- Diet Supplement Health and Education Act (DSHEA) passed in 1994
- National Center for Complementary and Alternative Medicine (NCCAM) established in 1998.
- Insurance began to cover questionable treatments
- “Quackademic” medicine began to infiltrate hospitals and medical schools.

The growing popularity of CAM may be attributed to multiple factors, including misunderstandings about science and a distrust of the medical establishment.

Studies have evaluated its pattern of use:

- Percentage of people who use CAM:
 - 62% if prayer is included

- 36% if prayer is excluded.
- Percentage who use each modality:
 - Natural products 19% (Echinacea, ginseng, ginkgo, and garlic top the list)
 - Breathing exercises 12%
 - Chiropractic 7.5%
 - Acupuncture and homeopathy account for less than 1% each.
- Reasons for choosing CAM:
 - Top 3: back and other musculoskeletal pain 50%, colds 9.5%, anxiety/depression 4.5 %
 - 3.7 to 2.2%: stomach, intestinal problems, headaches, insomnia
 - 1% each: sinusitis, cholesterol, asthma, blood pressure, menopause
- Characteristics of CAM users: more likely to be women, not very young or very old, Asians>Hispanics>whites>blacks, more educated, higher income, private health insurance, live in urban areas, former smokers, users of alcohol, recently hospitalized.

Characteristics of CAM:

- Lack of adequate testing or even denial of need for testing
- Acceptance of anecdotal evidence and poorly documented case studies.
- Ideology that ignores biologic mechanisms, disparages modern science, and favors natural remedies.
- Range of plausibility from high (herbal medicine) to zero (homeopathy).
- Some CAM providers are deliberately fooling patients; others have fooled themselves

Summary of evidence by R. Barker Bausell in *Snake Oil Science*: “There is no compelling, credible scientific evidence to suggest that any CAM therapy benefits any medical condition or reduces any medical symptom (pain or otherwise) better than a placebo.”

Summary of evidence by Singh and Ernst in *Trick or Treatment*:

- While there is tentative evidence that acupuncture might be effective for some forms of pain relief and nausea, it fails to deliver any medical benefit in any other situations and its underlying concepts are meaningless.
- With respect to homeopathy, the evidence points towards a bogus industry that offers patients nothing more than a fantasy.
- Chiropractors, on the other hand, might compete with physiotherapists in terms of treating some back problems, but all their other claims are beyond belief and can carry a range of significant risks.
- Herbal medicine undoubtedly offers some interesting remedies, but they are significantly outnumbered by the unproven, disproven and downright dangerous herbal medicines on the market.

Placebos

- CAM argues that even if it doesn't work better than a placebo, we should use it anyway because placebos make patients feel better.
- It can be dangerous for patients to think they feel better when they are not objectively better.
- Placebos only "work" for certain subjective symptoms like pain
- The effect is unpredictable, small, and not lasting
- Placebos "work" for animals because of the effect on owners' perceptions.
- Placebo use can delay effective treatment
- Placebos are essential for placebo-controlled trials in research, but they have no place in clinical practice because they are unethical and they are not even needed: the nonspecific contextual effects of the doctor/patient encounter act in the absence of any placebo "object."

Integrative medicine combines mainstream medicine with CAM.

- Like integrating fantasy with reality
- Integrating cow pies with apple pies doesn't improve the taste of either
- Integrative medicine has been called lipstick on the ideological pig of CAM

Another definition of CAM: "A spectrum of implausible beliefs and claims about health and disease. These range from the untestable and absurd to the possible but not very intriguing. In all cases the enthusiasm of advocates vastly exceeds the scientific promise."

Lecture 3: Chiropractic

Chiropractors (DCs) are not doctors and must be distinguished from DOs.

False claims:

- Chiropractic is a science.
- Chiropractic is based on neurology, anatomy and physiology.
- Chiropractors are doctors of the nervous system.
- Chiropractic improves health and quality of life.

Reality:

- Invented by a grocer all by himself in a single day: September 18, 1895.
 - D.D. Palmer believed all illness was caused by bones out of place
 - He extrapolated from a single case based on a misunderstanding of anatomy
- Based on false theory
 - The mythical chiropractic “subluxation”
 - Impairment of nerve flow
 - Interference with a mystical vitalistic power (“Innate”) that maintains health
- Chiropractic manipulation can have adverse effects
 - Strokes from neck manipulation
 - Broken bones, herniated disc, paralysis, death
 - Half of all patients have mild to moderate side effects
- Often associated with quackery
 - **Bogus tests** used by some chiropractors: Biological Terrain Assessment, computerized "nutrient deficiency" testing, contact reflex analysis, contour analysis (also called moiré contourography), cytotoxic testing, other improper allergy testing, electrodermal screening, Functional Intracellular Analysis (FIA), hair analysis, herbal crystallization analysis, iridology, leg-length testing (to check for "subluxations"), live blood cell analysis (also called nutritional blood analysis or Hemaview), testing with a Nervo-Scope, Nutrabalance, NUTRI-SPEC, pendulum divination, reflexology, saliva testing, spinal ultrasound testing to "measure progress," surface electromyography (SEMG), thermography, testing with a Toftness device, weighing on a twin-scale device (Spinal Analysis Machine).
 - 43% of American chiropractors use applied kinesiology, a bogus muscle testing procedure, for both testing and treatment.
 - **Bogus treatments** used by many chiropractors: acupuncture, Activator Methods, applied kinesiology, Bio Energetic Synchronization Technique (B.E.S.T.), chelation therapy, colonic irrigation, cranial or craniosacral therapy, laser acupuncture, magnetic or biomagnetic therapy, Neuro Emotional Technique

- (NET), Neural Organization Technique (NOT), homeopathic products, unproven dietary supplements or herbal products.
- Some chiropractors do bad things:
 - Unnecessary x-rays
 - Unethical advertising
 - 50% discourage immunizations
 - Discourage conventional medical care
 - Offer lifelong “maintenance” adjustments
 - Miss diagnoses and fail to refer appropriately
 - Treat young children and even newborns whose spine hasn’t finished forming.
 - Presume to function as family doctors

Types of chiropractors:

- Straights: do chiropractic adjustments only
- Mixers: add other treatments, everything from massage to voodoo
- Upper cervical chiropractors: only adjust the top vertebra in the neck
- “Reform” chiropractors who reject the subluxation concept and try to practice evidence-based chiropractic.

The only thing chiropractors do that has been definitely proven effective is spinal manipulation treatment (SMT) for certain types of low back pain.

- There’s nothing uniquely “chiropractic” about SMT: it’s also used by physical therapists, DOs, and others.
- It’s no more effective in the long run than other treatments for low back pain, but it is a reasonable option for people who prefer it, and it may offer earlier relief.

If you want to see a chiropractor, here’s what you should look for:

- Rejects subluxation theory
- No full spine x-rays
- No quack procedures or tests
- No preventive or maintenance adjustments
- No promotion of unproven dietary supplements
- Doesn’t pretend to be family doctor
- Doesn’t treat young children
- No antagonism to scientific medicine
- Doesn’t discourage immunizations
- Limited to short-term treatment of musculoskeletal problems
- Knows when to refer
- Bottom line: If a chiropractor offers SMT for short-term treatment of certain kinds of musculoskeletal pain, he might be able to help you. If he offers to “adjust your subluxations”, or to treat problems elsewhere in the body, it’s best to avoid him.

Horror stories illustrate just how unscientific chiropractors can be.

Chiropractic research

- Studies are generally poor quality, usually without controls, and often are simply case reports that are poorly documented.
- No evidence supports spinal manipulations for somatovisceral diseases
- No real progress has been made in over a century
- Their research has never found a treatment ineffective
- They keep adding treatment methods and never give any of them up.

Lecture 4: Acupuncture

Alternative medicine is medicine that hasn't been proven to work. Most people think acupuncture has been proven to work, but everything you've heard about acupuncture is false.

The theory of acupuncture says:

- There is a vitalistic energy called *qi*
- *Qi* flows through mythical "meridians"
- Disease is caused by blockages of *qi*
- The flow of *qi* can be restored by inserting needles at "acupoints."

Qi, meridians, and acupoints are mythical: they have never been shown to exist.

None of the following are true:

- It's an ancient Chinese treatment method.
- Involves sticking needles in acupoints
- It's widely used in China.
- Works to relieve pain and nausea.
- Works for other conditions like infertility.
- Can be used for surgical anesthesia.
- Is harmless – no side effects.
- Has been validated by scientific research

The truth:

- It's not as ancient as they claim, and one kind of acupuncture was invented in 1957.
- It may not be Chinese: may have originated in Greece
- Not "a" method, but many different methods.
- Many acupuncture methods don't use needles.
- Not widely used in China:
- Acupuncture anesthesia is a myth
- It's never used alone for anesthesia, but only as an adjunct to local anesthetics, sedatives, and narcotics.
- There is disagreement as to the number of meridians and acupoints.
- It is used on animals but humans' interpretation of animal's response is influenced by suggestion, so alleged effects are likely placebo.

Could acupuncture effects be explained scientifically?

- Acupuncture increases endorphins, but so do placebo pills.
- Anatomical verification of acupoints has been attempted, but without success.
- There's no point in trying to explain *how* it works unless we can establish that it *does* work.

Does it work?

- It's claimed to work for all these conditions: addiction (such as alcoholism), allergies, anxiety, asthma, bronchitis, carpal tunnel syndrome, chemotherapy-induced nausea and vomiting, constipation, depression, diarrhea, endometriosis, facial tics, fibromyalgia, gastroesophageal reflux, headaches, high blood pressure, infertility, irregular menstrual cycles, kidney infections, memory problems, multiple sclerosis, PMS, polycystic ovarian syndrome, low back pain, menopausal symptoms, menstrual cramps, osteoarthritis, pain, pharyngitis, post-operative nausea and vomiting, psychological disorders, sciatica, sensory disturbances, sinusitis, spastic colon (often called irritable bowel syndrome), stroke rehabilitation, tendonitis, tennis elbow, tinnitus, and urinary problems such as incontinence, sports injuries, sprains, strains, ulcers, whiplash.
- It has been tested for all these conditions and only found effective for two of them: pain and nausea. And the apparent effectiveness in those cases can be explained by a placebo response.
- A study can be found to support almost any claim, but acupuncture studies are inherently flawed: double blind studies are impossible.
- The effects found in the positive studies are small and not clinically useful.
- The best studies show that it doesn't matter where you put the needles, it doesn't matter if you use real needles or sham needles; all that matters is whether the patient believes he got true acupuncture.
- A systematic review of systematic reviews found a mix of negative, positive and inconclusive results consistent with the noise that would be expected when studying an ineffective treatment.

Acupuncture is not harmless

- There are at least 95 published reports of serious adverse effects including 5 deaths.
- There are several contraindications.
-

Some acupuncturists accept that it is just a placebo but want to use it anyway.

Scientists who have evaluated all the published evidence for acupuncture remain skeptical:

- The Center for Inquiry said positive effects were due to expectation.
- The *Medical Letter* said it "has not been shown in rigorous, duplicated studies to benefit any defined medical condition."
- Edzard Ernst and Simon Singh concluded that there was only "tentative" evidence that it "might" be effective for some forms of pain relief and nausea, but that it fails to deliver any medical benefit in any other situations, and its underlying concepts are meaningless.
- David Colquhoun and Steven Novella concluded that "Acupuncture is no more than a theatrical placebo."

Continuing to study acupuncture would be a waste of research funds.

Lecture 5: Homeopathy

Many people have no idea what homeopathy is; they think it's just some kind of herbal medicine. Actually it's incredibly silly. It has been called "the ultimate fake" and "delusions about dilutions."

A simplified explanation of how homeopathy is supposed to work:

- If coffee keeps you awake, dilute coffee will put you to sleep.
- The more dilute, the stronger the effect.
- If you dilute out all the coffee molecules, the water will remember them and the effect will be even stronger.
- The water's memory can be transferred to a sugar pill by dripping the water onto a sugar pill and allowing it to evaporate.

The history of homeopathy:

- Invented by Samuel Hahnemann in the early 1800s.
- Conventional medicine of the time was pre-scientific and did more harm than good.
- He experimented with cinchona bark, used to treat malaria, and mistakenly thought it gave him the same symptoms as malaria.
- He developed two basic principles of homeopathy:
 - The Law of Similars, or Like Cures Like. A remedy will cure an illness if it causes the symptoms of that illness in a healthy person.
 - The Law of Infinitesimals: the smaller the dose, the larger the effect.
- He got better results with home visits, so he imagined that the jostling in his saddlebags made the remedies more effective. Henceforth he used succussion: pounding the bottle of remedy repeatedly against a leather-bound book at every stage of the dilution.

The dilutions:

- A 6X remedy was prepared by diluting one part of remedy in 10 parts of water and repeating the dilution 6 times, giving a dilution of 1 part in a million.
- A 6C remedy was prepared by diluting one part of remedy in 100 parts of water and repeating 6 times.
- By the 13 C or 26X level, there are no molecules of the original substance left.
- A typical homeopathic remedy is 30C. At that level, it would take a container 30 million times the size of the Earth to hold enough water to make sure you were getting at least one molecule of the original substance.
- The most popular homeopathic flu remedy is 200C, and many remedies are even more dilute. 200C is 10 to the 400th power, and the number of atoms in the observable universe is 10 to the 80th power.

Attempts to justify homeopathy are irrational, invoking nonexistent similarity to vaccination and hormesis, which both require measurable amounts of the original substance; and speculating about water clusters and quantum entanglement.

Homeopathic remedies are based on “provings” in healthy volunteers – an uncontrolled, unsystematic, unscientific method.

There are different kinds of homeopathy:

- In classic homeopathy only one remedy is given at a time
- In combination homeopathy, a mixture of remedies for the same symptoms is used
- Homeopathic remedies are also sold over the counter for self-prescription

Visiting a homeopath:

- Initial visit 1 hour, detailed history of illness plus all kinds of irrelevant factors. Example given of patient with uterine fibroids who is noted to be loud and loquacious, to feel humiliated, and to have had an absence of nurturing in childhood, among many other factors not related to fibroids.
- Homeopath consults a Repertory that lists things like a facial expression that is “besotted” or “anxious during downward motion.” Each symptom is listed with all the remedies that are likely to help.
- Then he consults a *Materia Medica* that lists symptoms associated with each remedy. Example given for a remedy with pages and pages of symptoms listed for 17 areas of the body, including things like dreams of robbers and chill between 9 and 11 am. The cause of all these symptoms and the remedy for them? Table salt!
- He decides which remedy best suits the patient’s symptoms, and chooses one. Some examples of remedies are Berlin wall, eclipsed moonlight, the south pole of a magnet, a dog’s earwax, tears from a weeping young girl, fossilized dinosaur bone, rattlesnake venom, arsenic, and poison ivy.
- For followup, the patient is constantly re-evaluated. Worsening symptoms are interpreted as a sign the remedy is working. When homeopathy fails, the patient is blamed for doing things that might have counteracted the remedy, like drinking coffee or using a cellphone.

Miasms: Hahnemann developed another theory to explain the failures of homeopathy; he said all disease was caused by 3 miasms:

- Syphilis
- Sycosis (gonorrhoea)
- Psora (scabies or itch)

Evidence?

- Early successes: homeopathy appeared to be more effective than medicine because doctors of that time did more harm than good, and homeopathy did nothing.

- Modern clinical trials fail to show effectiveness.
- If homeopathy were true, it would mean that well-established knowledge in physics, chemistry and biology is wrong.
- Jay Shelton wrote a book about homeopathy, examined the evidence, and concluded that homeopathy often helps people, but the remedies don't contribute. It "works" because of non-remedy factors:
 - Unassisted natural healing
 - Attention, suggestion
 - Placebo effects
 - Regression to the mean
 - Cessation of harmful or unpleasant treatments.
 - Lifestyle-assisted healing
 - Internal reality vs. external reality
- Systematic reviews of the evidence:
 - 2 positive, 9 negative out of 11 reviews
 - When the lowest quality trials were omitted, all reviews were negative
 - The most positive review had declared "overall it worked better than placebo, but it didn't work better for any specific condition"!

Homeopathy had nearly disappeared in the US until it saw a resurgence with the CAM movement.

Examples of homeopathic idiocy:

- The silliest and best-selling homeopathic remedy of all is oscillococcinum: a dilution supposedly containing bacteria that never existed, prepared by diluting a bit of duck liver diluted until only the quack is left.
- Homeopathic "vaccines" are intended to replace real vaccines.
- A homeopath fixed a car with electrical problems by writing Electricitas 200C on a piece of paper and placing it near the engine.
- Homeopathy First Aid Kits

Lecture 6: Naturopathy and Herbal Medicines

Naturopathy is poorly defined, based loosely on avoidance of drugs and surgery, use of natural treatments, emphasis on prevention, and a vitalistic philosophy. It was founded by Benedict Lust in 1901. NDs are licensed in only 17 states and prohibited in 2.

Education:

- 5 accredited schools grant the ND degree. There are also unaccredited correspondence courses in “Traditional Naturopathy.”
- Schools claim to offer “more basic science than MDs,” but they also teach homeopathy, iridology, and other quackery, and little of what they do is based on science.
- No hospital experience or experience with seriously ill patients or with prescription meds.
- The standard textbook omits things doctors should know, and recommends non-science-based treatments.

Their stated basic principles are:

1. First do no harm.
2. Physician as teacher.
3. Treat the whole person.
4. Prevention.
5. Healing power of nature.
6. Treat the cause

These are also the basic principles of mainstream medicine, and naturopaths actually tend to violate them. The “causes” they treat are fanciful, and as for prevention, their patients are less likely to be vaccinated or to have screening tests like mammograms.

Naturopathy is attractive to patients for a number of reasons, but it can harm and kill. Examples given.

Herbal medicines:

- Said to be better than prescription drugs because they are natural, have synergistic effects, are milder, and have no side effects. All of these are false.
- The *Natural Medicines Comprehensive Database* is the best source of information.
- Reasons not to choose herbal medicines:
 - Unwanted components
 - Information inadequate, misleading, incomplete, or unavailable
 - Difficulty controlling dose
 - Contaminants and adulterants
 - Content may not correspond to label
 - Ineffective regulation

- Inadequate monitoring
- Interactions
- There is usually a more effective pharmaceutical

Conclusion:

- Naturopaths combine commonsense health and nutrition measures and rational use of a few herbs with a huge variety of unscientific practices and anti-medical double-talk.
- What they do that is good is not special, and what they do that is special is not good.
- The risks to many sick patients seeking care from the average ND would far outweigh any possible advantages.

Lecture 7: Energy Medicine

The NCCAM recognizes two kinds of energy:

- Veritable (real) energies that can be measured
 - Magnets, sound and electricity have proven applications in medicine
- Putative energies that “have yet to be measured.” Their existence has not been demonstrated, much less any effect on health.
 - Includes biofields, human energy field, qi or chi, prana, mana, pneuma, vital fluid, orgone, etc.

Energy medicine claims that there is an energy field undetectable by scientific instruments that somehow gets out of balance, somehow causes illness, and somehow can be adjusted by practitioners to restore health.

Some historical examples:

- Mesmer’s animal magnetism
- Perkins’ tractors
- Victorian quack electrical devices
- Abrams radionics devices
- Reich’s orgone energy accumulator

Some modern examples of energy medicine:

- Reiki
- Eric Pearl’s reconnective healing
- Yoga
- Crystal healing
- Medical intuitives
- Emoto’s water crystals
- Electrodermal testing
- Power Balance bracelets

Energy medicine is not measurable, not falsifiable and therefore is not in the realm of science. Steven Novella has called it “a perfect example of cargo-cult, Tooth Fairy, noise-based pseudoscience.”

- Cargo cult science imitates science without understanding it
- Tooth Fairy science applies scientific methods to something imaginary
- Signal to noise ratio: signal can’t be distinguished from background noise

Attempts to study putative energies

- Reiki: studies unreplicated, contradictory, no evidence that it’s an effective treatment for any condition
- Therapeutic touch
 - Emily Rosa’s experiment: practitioners who claimed they could sense the human energy field failed a test devised by a child
 - They were fooling themselves

- Gary Schwartz's book *Energy Healing Experiments*
 - Experiments poorly designed, never replicated, never published
 - Never tries to rule out other explanations
 - Goes off on tangents, skips from studying one thing to another
- Oschman's book *Energy Medicine: The Scientific Basis*
 - The "evidence" he presents boils down to two flawed, unreplicated studies plus a lot of imaginative speculation.
 - The energies he claims to measure are too weak to affect the body
- Biophotons
 - Random by-product of human metabolism
 - Ultraweak, unlikely to have any effect or create coherent web
 - No mechanism for carrying information
- Kirlian photography
 - Captures the phenomenon of electrical coronal discharges
 - Not a human "aura;" inanimate objects have it too.

Pseudophysics tries to justify magical thinking by using irrelevant jargon from modern physics.

- Quantum flapdoodle used to explain anything mysterious.
- Real physics asks questions that pseudophysics never thinks to ask
- Purports to explain spooky action at a distance, like Adam Dreamhealer's alleged ability to heal remotely.

Better, logical explanations for energy medicine phenomena:

- For symptom relief:
 - Placebo effect
 - *Post hoc ergo propter hoc* (improvement unrelated to therapy)
- For experimental results:
 - Psychological mechanisms
 - Experimenter bias
 - Methodological flaws
 - Fabricated data and scientific misconduct
 - Noise based science, Tooth Fairy science

What would it take to prove the human energy field was real? A large body of evidence that was:

- Quantifiable
- Reproducible by non-believers
- Coherent and consistent, with large effect sizes
- Arrived at same conclusion using several different routes of investigation.
- Showed progress as new evidence built on older findings.

Energy medicine is easy and profitable: Braco the Gazer makes millions by standing onstage for 5-10 minutes and "healing" people by doing nothing but gazing at the audience.

Lecture 8: Miscellaneous “Alternatives”

7 Zombie memes:

There are recurrent memes or myths in CAM that refuse to die. Like zombies, they keep rising up again no matter how many times they have been debunked.

1. The bogus homunculus, a representation of the entire body mapped onto a single part of the anatomy (in ear acupuncture, iridology, reflexology, etc.)
2. Food as medicine: the myth that food cures all disease; nutraceuticals
3. The myth that proper diet will prevent all disease
 - a. In reality, only about 1/3 of cancers might be prevented by diet
 - b. We're not sure what the ideal diet is, and diets like the paleo diet, blood type diet, etc. are not based on evidence
4. The myth that certain foods have unique health benefits (superfoods, tropical superfruits, fads, Ayurveda, nutrigenomics)
5. The myth that effortless weight loss is possible
6. The detoxification delusion (the body doesn't need any help to remove toxins; detox treatments are useless and potentially harmful)
7. Autointoxication: the idea that retained feces are poisoning the body (doctors have never seen any such thing)

More odds and ends:

Breatharians who live only on air

Liver flushes

Ear candles

Longevity clinics

Vitamins

Bogus oxygen therapies

Magnet therapies

The rest of the zoo – from aromatherapy to urine therapy

Lecture 9: Pitfalls in Research

We depend on science for our knowledge, but a lot of things can go wrong in scientific research that can mislead us.

Ioannidis showed that most research findings are false, especially if:

- Small studies
- Small effect size
- Multiple endpoints
- Financial interests and bias
- Hot topic with more teams in competition

Research on improbable areas of CAM even more likely to be false.

Take precautions:

- Don't trust the media
- Learn what can go wrong
- Never believe one study
- Consider prior probability
- Ask questions

Questions to ask:

- People or fruit flies? Was the study in animals, in vitro, or in humans?
- Bausell's quick checklist:
 - Is the study randomized with a credible control group?
 - Are there at least 50 subjects per group?
 - Is the dropout rate 25% or less?
 - Was it published in a high-quality, prestigious, peer-reviewed journal?
 - You can look up the journal's impact factor
- Who are the subjects? Are they representative? Biased?
- Who's paying?
- Who are the authors? Biased? Conflict of interest?
- Was randomization adequate?
- Was blinding effective?
- Were there multiple endpoints?
- Was there inappropriate data mining?
- Where was the study done?
- Were the results clinically meaningful?
- What does statistical significance really mean?
 - Arbitrary cutoff: $p=0.05$
 - P-value measures the probability that you would get the results you did if there was really no difference between the two groups.
 - Statistical significance \neq Truth, and Truth \neq Clinically significant
- What are the confidence intervals?
- Did they report absolute or relative risk?

- What are the numbers needed to treat and harm (NNT, NNH)?
- Did they mistake correlation for causation?
- Did they tell you the base rate?
 - Sensitivity = percentage of people with the disease who test positive
 - Specificity = percentage of people without the disease who test negative
 - Specificity and sensitivity tell you nothing unless you know the base rate, the percentage of people in the population being studied who actually have the disease.
 - Positive predictive value (PPV): if test is positive, what's the likelihood that you actually have the disease?
 - Negative predictive value (NPV): if test is negative, what's the likelihood that you actually don't have the disease?
 - The lower the prevalence of the disease, the poorer the PPV.
- Could there have been fraud?
- What else might have gone wrong?
 - Errors of math
 - Using the wrong statistical test for the kind of data collected
 - Contaminants
 - Poor compliance
 - Conscious or unconscious manipulation of data by technicians
 - Procedures not carried out properly
 - Data may be good but conclusion may be wrong

Two kinds of study very likely to be wrong:

- Tooth Fairy science – trying to study things that don't exist
- Pragmatic studies of improbable treatments
 - Clinical trials are done on select subjects in an artificial setting; pragmatic studies look at real-world everyday performance
 - Not meant to establish whether a treatment works better than placebo.
 - An unproven treatment with strong placebo effects may falsely appear to perform better than an evidence-based treatment.

The SkepDoc's Rule: before you accept any claim, make sure you understand who disagrees with it and why.

Different standards of proof:

SBM requires:

- Scientifically plausible mechanisms
- Rigorous trials showing replicable, statistically and clinically significant effects

CAM:

- Softens standards, makes excuses
- Often suggests RCTs inappropriate for CAM

- Substitutes pragmatic studies for efficacy studies
- Interprets placebo effects as if they were proof of efficacy
- Has a more flexible concept of “evidence,” often accepting testimonials.

Don't forget to ask if you yourself might be biased.

John Rennie said:

- “There seems to be no study too fragmented, no hypothesis too trivial, no literature citation too biased or too egotistical, no design too warped, no methodology too bungled, no presentation of results too inaccurate, too obscure, and too contradictory, no analysis too self-serving, no argument too circular, no conclusions too trifling or too unjustified, and no grammar and syntax too offensive for a paper to end up in print.”

Problems that need correcting:

- Poor quality studies
- Publish or perish
- Publication bias
- Lack of replication
- Mistakes missed by peer review
- Pay-to-publish journals
- Big Pharma malfeasance

Solutions:

- Better education of researchers
- Quality control at journals
- Publish replications and negative studies
- Register all studies
- Full disclosure
- Improve media reporting

This warning statement should be attached to all research studies:

- “Warning! Taking any action on the basis of this research could result in injury or death. The results described in this study have not been replicated and the long term effects of this treatment are unknown. Past performance is no guarantee of future results. When subjected to further investigation, most published research findings turn out to be false.”

Science isn't perfect, but it's better than anything else. It's a collaborative effort that is self-correcting over time. We can't trust any individual study, but when experts in the field analyze all the available data and come to a consensus, they are likely to come as close to the truth as current knowledge allows.

Lecture 10: Science-Based Medicine in the Media and Politics

We have regressed from the Age of Enlightenment to an Age of Endarkenment.
The public is appallingly ignorant about science.

The media do a very poor job of reporting on medical science.

- An example of a study that was reported as both positive and negative.
- Celebrities spread misinformation and quackery: Jennie McCarthy, Suzanne Somers, Andrew Weil, Oprah, Dr. Oz.
- Unreliable information on the Internet, with specific bad examples

Politicians are science-illiterate and pass laws that disregard science.

- The National Center for Complementary and Alternative Medicine
 - Agenda shaped by politics, not science
 - Wastes money on junk science studies
 - Unethical trials (TACT, the Gonzalez trial)
- The Diet Supplement Health and Education Act (DSHEA)
 - Weakened the ability of the FDA to protect consumers
 - Markets products for use as medicines under the fiction that they are not medicines but supplements to diet
- The Affordable Care Act
 - Prohibits discrimination against any licensed health care provider
 - Authorizes payment for quackery

Licensing of CAM providers is a bad idea.

- Intended to protect the public but actually does the opposite
- Legalizes quackery and fraudulent practices
- Allows the fox to guard the henhouse
- Legitimizes CAM in the eyes of the public

Quackademic Medicine

- The 1910 Flexner Report established scientific standards for medical schools.
- Those standards have been betrayed
- Medical schools must now teach CAM to be accredited.
- Integrative medicine programs include homeopathy and therapeutic touch
- Several factors contribute to this development, from money to postmodernism.

CAM can't be abolished

- Ways of minimizing the harm
- Signs of hope

For further reading:

Websites

Science-Based Medicine: www.sciencebasedmedicine.org

Quackwatch: <http://www.quackwatch.com/>

Chirobase: <http://www.chirobase.org/> (affiliated with Quackwatch, best website for information about chiropractic)

The Skeptic's Dictionary: <http://skeptdic.com/>

What's the Harm: <http://whatstheharm.net/>

The Society for Science-Based Medicine: <http://sfsbm.org>

Blogs

Neurologica: <http://theness.com/neurologicablog/>

Respectful Insolence: <http://scienceblogs.com/insolence/>

DC's Improbable Science: <http://www.dcscience.net/>

Edzard Ernst: <http://edzardernst.com/>

Bad Science: <http://www.badsience.net/>

The Quackometer: <http://www.quackometer.net/blog/2012/01/why-is-homeopathy-successful.html>

Naturopathic Diaries <http://www.naturopathicdiaries.com/> (confessions of an ex-naturopath)

Articles

Why Bogus Therapies Seem to Work, by Barry Beyerstein

http://www.csicop.org/si/show/why_bogus_therapies_seem_to_work/

The One True Cause of All Disease, by Harriet Hall

http://www.csicop.org/si/show/one_true_cause_of_all_disease/

Acupuncture is Theatrical Placebo, by David Colquhoun and Steven Novella

<http://www.sciencebasedmedicine.org/acupuncture-doesnt-work/>

Explanation of Placebos: <https://www.sciencebasedmedicine.org/placebo-are-you-there/>

The Evidence for Evidence-Based Medicine

http://www.sram.org/media/documents/uploads/article_pdfs/5-2-06.lmrie-Ramey.pdf

Videos

Medical Myths, Lies, and Half-Truths: What We Think We Know May Be Hurting Us. By Steven Novella. The Great Courses.

http://www.thegreatcourses.com/tgc/courses/course_detail.aspx?cid=1924

Video of Tong Ren: <https://www.youtube.com/watch?v=I4r3FrzFBc>

ReasonTV: *The Alternative Health Racket: How the Feds Fund Quacks*
<https://reason.com/reasontv/2015/09/04/alternative-medicine-racket>

Books

Best books on Alternative Medicine:

Trick or Treatment: The Undeniable Facts about Alternative Medicine, by Simon Singh and Edzard Ernst

Snake Oil Science: The Truth About Complementary and Alternative Medicine
by R. Barker Bausell

Do You Believe in Magic?: The Sense and Nonsense of Alternative Medicine by Paul Offit

Best books on chiropractic

Inside Chiropractic: A Patient's Guide by Samuel Homola
Chiropractic Abuse: An Insider's Lament, by Preston Long

Best book on homeopathy

Homeopathy: How It Really Works, By Jan Shelton

On Errors in Thinking:

Why People Believe Weird Things: Pseudoscience, Superstition, and Other Confusions of Our Time, by Michael Shermer

The Believing Brain: From Ghosts and Gods to Politics and Conspiracies---How We Construct Beliefs and Reinforce Them as Truths, by Michael Shermer

On Being Certain: Believing You Are Right Even When You're Not by Robert Burton

Unnatural Acts: Critical Thinking, Skepticism, and Science Exposed! By Robert Todd Carroll

More:

Bad Science, by Ben Goldacre

Bad Pharma: How Drug Companies Mislead Doctors and Harm Patients by Ben Goldacre

Taking the Medicine: A Short History of Medicine's Beautiful Idea, and Our Difficulty Swallowing It by Druin Burch

Healing, Hype or Harm? A Critical Analysis of Alternative Medicine by Edzard Ernst

Autism's False Prophets: Bad Science, Risky Medicine, and the Search for a Cure by Paul Offit

Consumer Health: A Guide to Intelligent Decisions, by Barrett, London, Kroger, Hall, and Baratz

Charlatan: America's Most Dangerous Huckster, the Man Who Pursued Him, and the Age of Flimflam by Pope Brock

Homeopathy and its Kindred Delusions by Oliver Wendell Holmes.