



# Malignant Hyperthermia

## "Hot Off the Press"

### 2014 PGA, NYC



*Ron Litman*

[litmanr@email.chop.edu](mailto:litmanr@email.chop.edu)

# Relevant Disclosures and Conflicts of Interests



# The New York Times

**Today, clouds, afternoon rain, intense, high 10. Tonight, a lot of rain early, some clearing, low 41. Tomorrow, a clearing shower, high 10. Weather map is on Page 16.**

© 2004 Blackwell Publishing Ltd, *Journal of Internal Medicine* 255: 103–110

© 2004 Blackwell Publishing Ltd, *Journal of Internal Medicine* 255: 105–112

DOI: 10.1002/for

© 2005 Blackwell Publishing Ltd *Journal of Internal Medicine* 258: 105–112

1988

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

**EXPERIMENTAL**, *et al.* — Short furry snakes with a limp. The only job the model had would be to show where the shoes had been to stand or sit longer than 15 minutes, otherwise pale sneakers from her closet and roller bags.

"Dressed goods," Mr. Farber describes instead, recalling how she recently confided to him whispering to her mother about whether the "capped lady" was a worth while.

Over almost five years, Mr. Farley, 45, stood alongside about a dozen other workers, spray gun in hand, gluing together thick cushions for chairs and couches and under brand names like Inoué, Ralph Lauren and Montecarlo. Fumes from the glue formed a persistent fog in the plant, and Mr. Farley's doctors say that breathing them is essentially the way of his nerve ailings, resulting in what he and his coworkers call "glue foot."

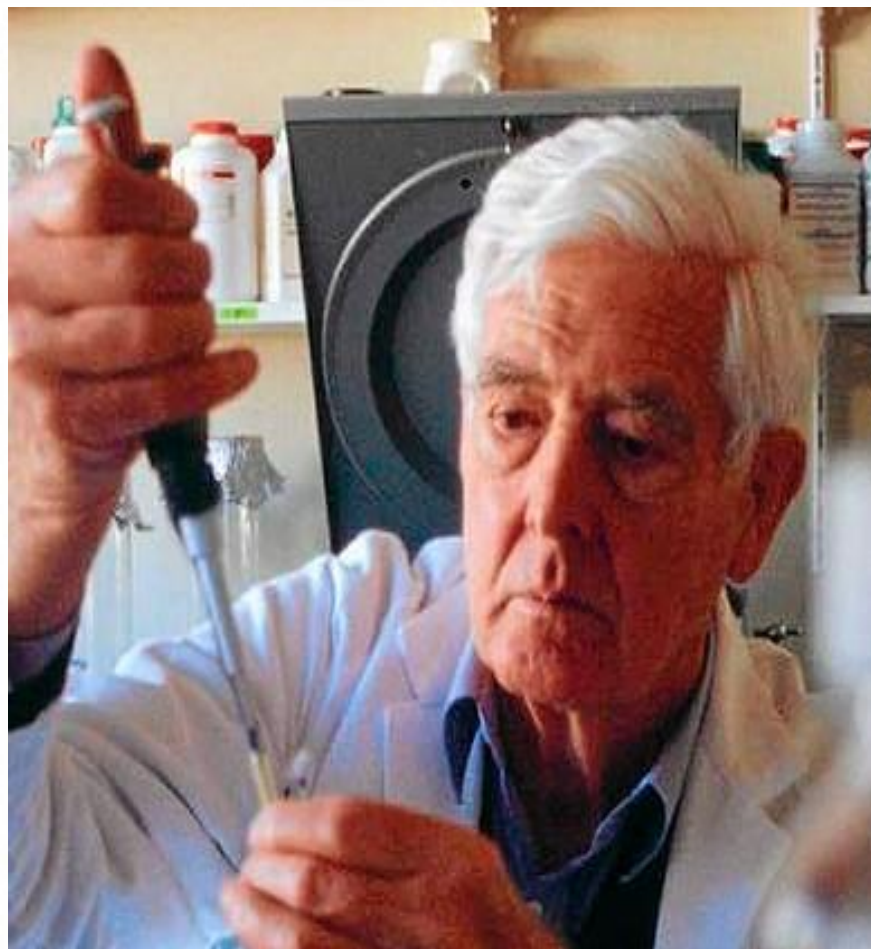
16. [The difference between a \*for\* loop and a \*while\* loop](#)

known as a group of mutants, or *spVs* — is also used by some of thousands of workers in such busy shops, dry cleaners and brightly illuminated restaurants having plastic covers for tables. Most of these mutants, government officials and some chemical companies that once marketed them *spVs* have warned for over a decade that if anyone overexposes skin damage and infertility when inhaled at low levels over long periods, that the use has proven to be safe in the past six years.

Such negative distinctions (the difficulty, changing demands of all sorts, of ensuring that Americans can be called upon at the job, from as far as other nations feel it, results from the International Safety and Health Administration, that means that managers at the job, conflict, being, where Mr. Farley was employed, especially, expressed, given to the fact that the American health system, which considered such, failed to provide inspiration and turned off the fact, that is, the fact, that,

But the story of the rise of a firm and the decline of Mr. Farley's health is much more than the tale of one company, or another chapter in the ongoing debate over the need for more, or better, government regulations. Instead, it is a parable about the law of unintended consequences.

It shows how an Environmental Protection Agency program moved to prevent the use of



***Michael Denborough,  
1929-2014***

*Sux  
Alone  
Causes  
MH:  
A&A  
Editors  
Declare  
War on  
Skin  
Temp*

already struggling to quell the  
last protests by the political ex-  
iles.

Parents already look hard for the jumps that require their kids, and they say they fear they will not have enough for the teachers to keep their school and month-to-month income the same.

United States officials aware of situation within Egypt must act now and a spokesman of the American embassy in Cairo said the United States will continue to be involved in the situation.





## HENRY ROSENBERG

### 2015 ASA DISTINGUISHED SERVICE AWARD WINNER

By LAURENCE

FAIRFAXVILLE, N.C. — Short, curly-haired with a long, thin nose, Mr. Rosenberg is the only job she could find would be one where she didn't have to stand or sit longer than 15 minutes, otherwise pain would shoot down her spine and up her legs.

"Damaged goods," Mr. Rosenberg described himself, recalling how he'd recently purchased a child whooping in her mother about whether the "copper baby" was a myth or not.

For about five years, Mr. Rosenberg, 45, stood alongside about a dozen other workers, spray gun in hand, gluing together foam cushions for chairs and couches sold under brand names like Tempur-Pedic, Ralph Lauren and Pottery Barn. From the glue formed a yellowish fog inside the plant, and Mr. Rosenberg's division was the only one of his that was eventually able to get away with no more work, resulting in what he and his coworkers call "dead time."

A chemical she handled —

known as isopropyl alcohol, or IPA — is also used by some of thousands of workers in auto body shops, dry cleaners and high-tech electronics manufacturing plants across the nation. Medical researchers, government officials and even chemical companies that once manufactured IPA have warned for over a decade that it causes neurological damage and infertility when inhaled at low levels over long periods, but its use has grown 30-fold in the past six years.

Such hazards demonstrate the difficulty, despite decades of effort, of ensuring that Americans can breathe clean air on the job. From an worker after worker fell ill, months from the Occupational Safety and Health Administration, which says that managers at the plant could be liable, where Mr. Rosenberg was employed repeatedly exposed glass to IPA levels that exceeded levels federal officials considered safe, failed to provide respirators and turned off fans meant to vent fumes.

But the story of the rise of IPA and the decline of Mr. Rosenberg's health is much more than the tale of one company, or another chapter in the national debate over the need for more, or better, government regulations. Instead, it is a parable about the law of unintended consequences.

It shows how an Environmental Protection Agency program meant to protect the use of



American Society of  
Anesthesiologists®



#### ECONOMIC FEARS DEEPEN

Government Is Pressed  
to Increase Taxes and  
Cut Subsidies

By DAVID S. KATZ

CAIRO, Egypt — A fuel shortage has helped send food prices soaring. Electricity is rationed and even before the summer. And gasoline shortages have killed at least five people and wounded dozens over the past two weeks.

The root of the crisis, economists say, is that Egypt is running out of the hard currency it needs for fuel imports. The shortage is raising questions about Egypt's ability to keep importing wheat that is essential to feed millions of people, raising fears of an economic catastrophe at a time when the government is already struggling to quell violent protests by the political elite.

Farmers already lack fuel for the pumps that irrigate their fields, and they say they fear they will not have enough for the harvest to reap their wheat next month before winter rains hit.

United Nations officials warn of disaster unless Egypt soon curbs not a package of tax increases and subsidies cuts but a



**MHAUS Hotline:  
800-MH-HYPER**



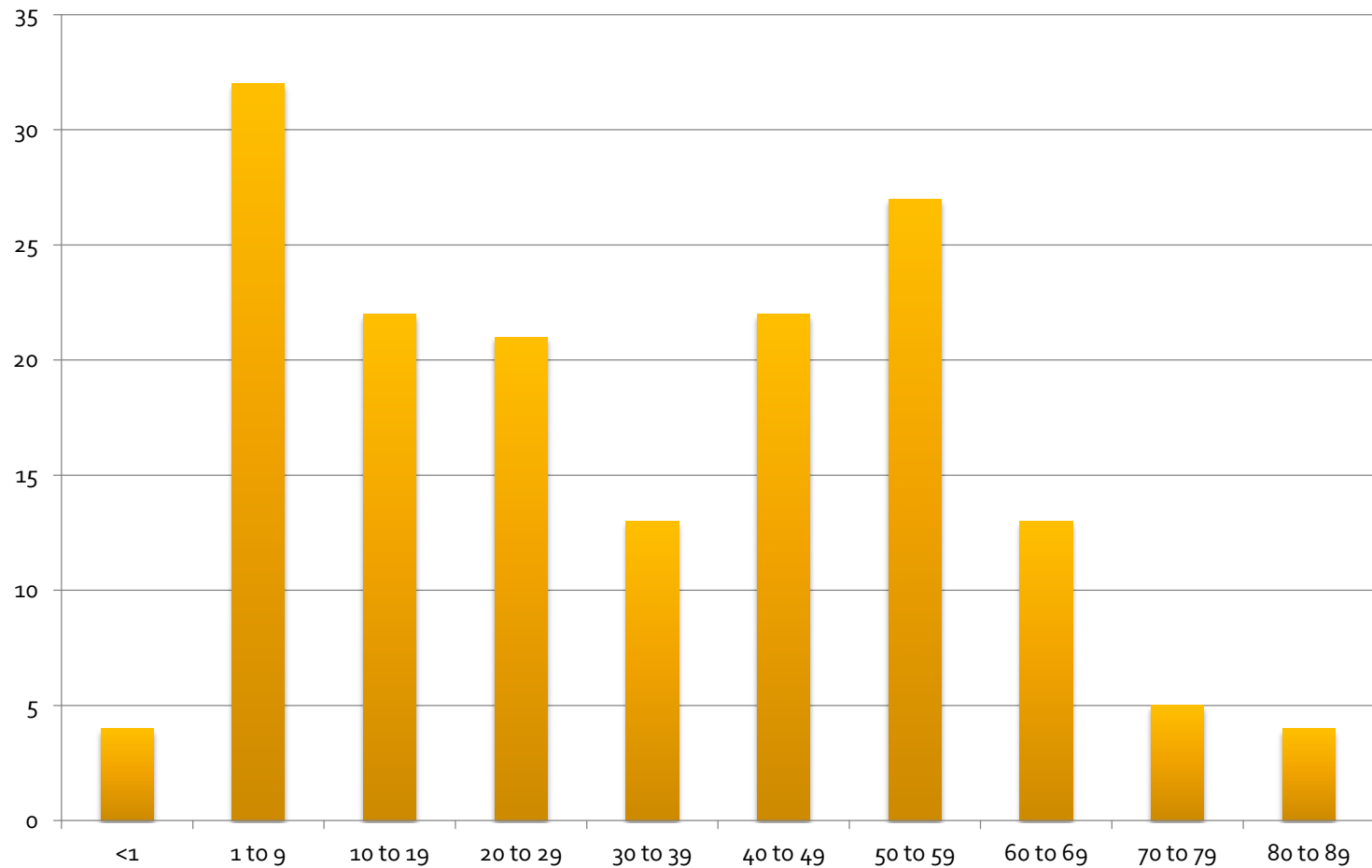
# MHAUS Hotline Stats 2014

- 31 Hotline consultants
- > 400 calls thus far 2014
- > 200 website queries



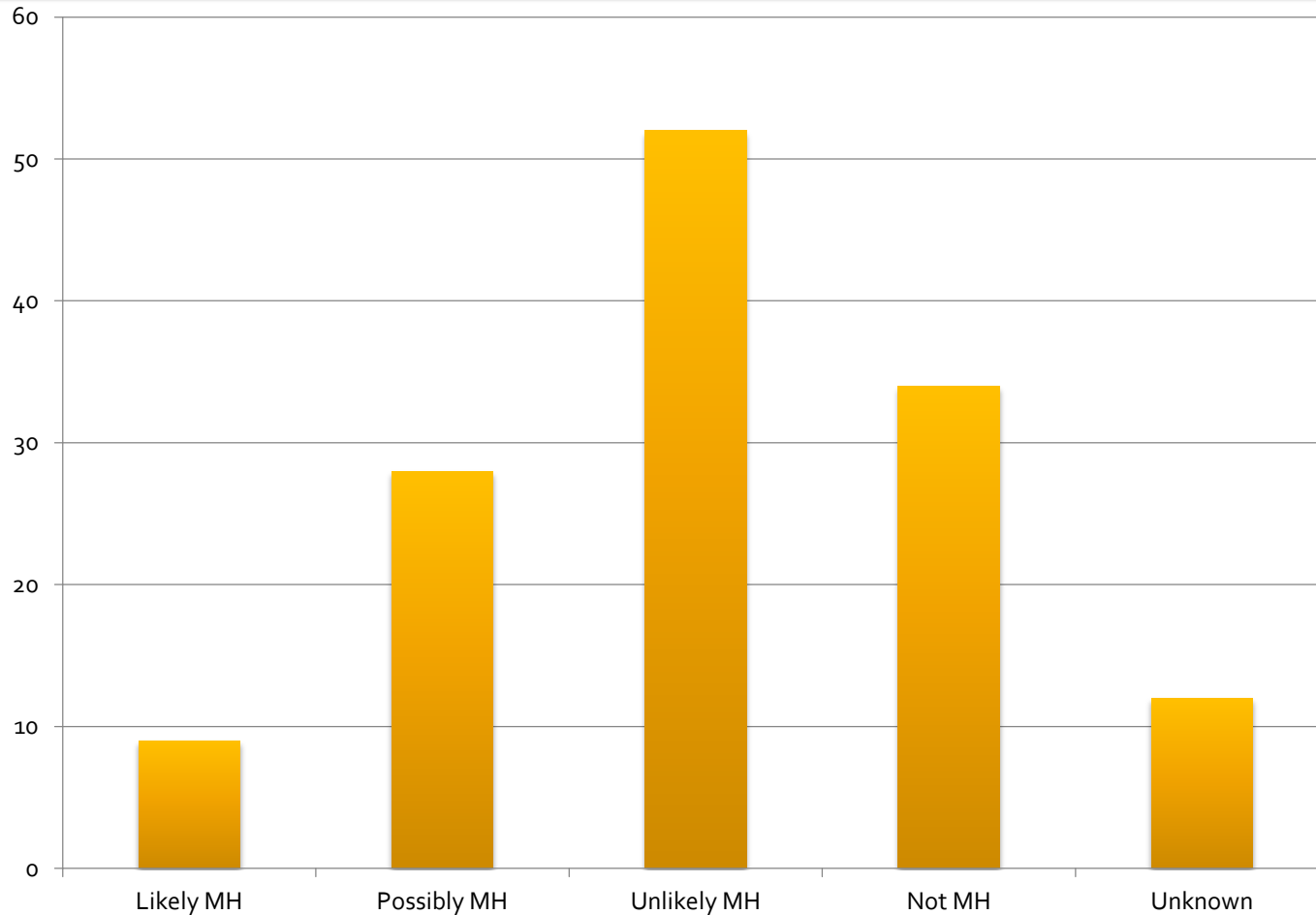
# MHAUS Hotline Stats 2014

## Ages of pts



# MHAUS Hotline Stats 2014

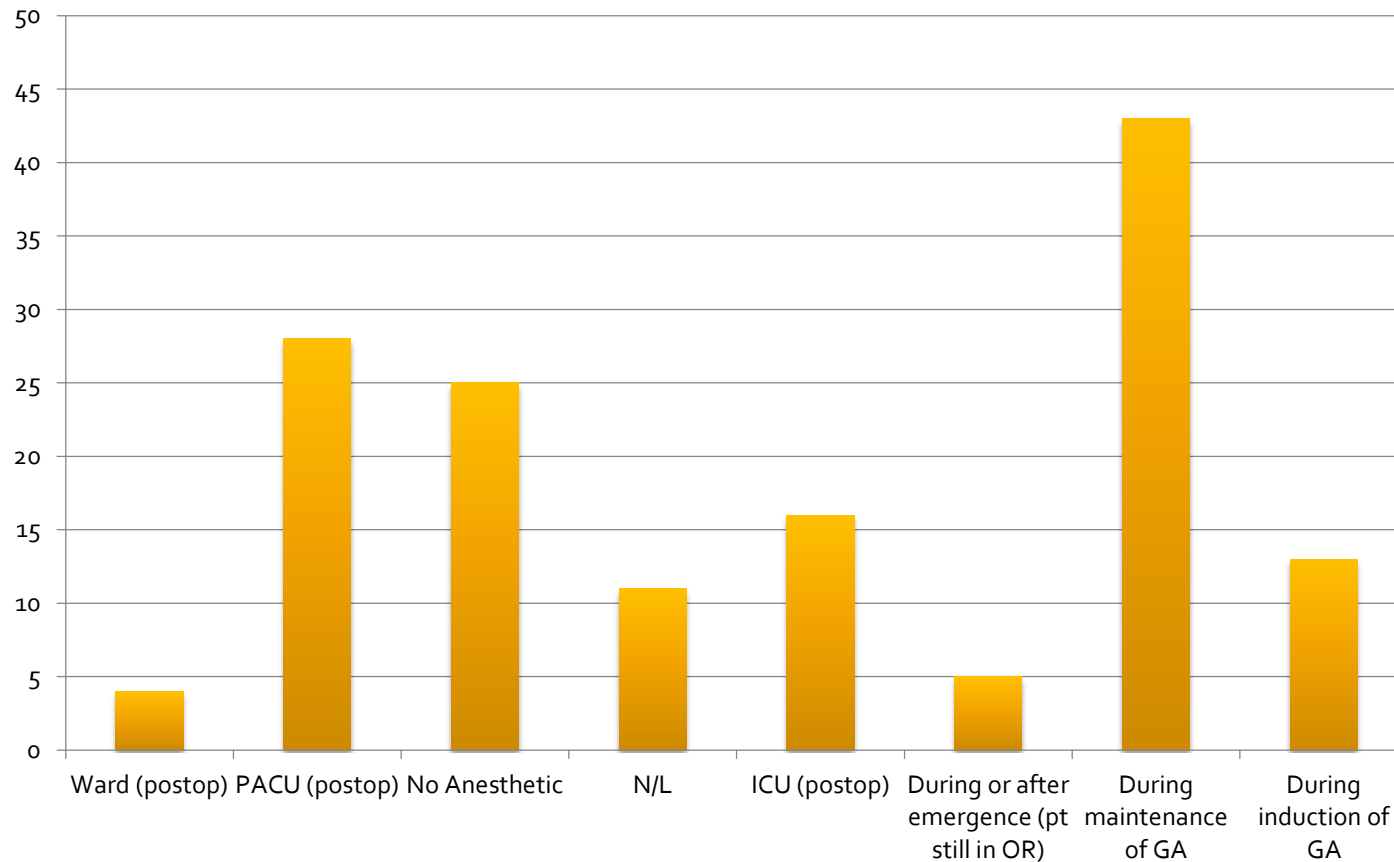
## Diagnoses



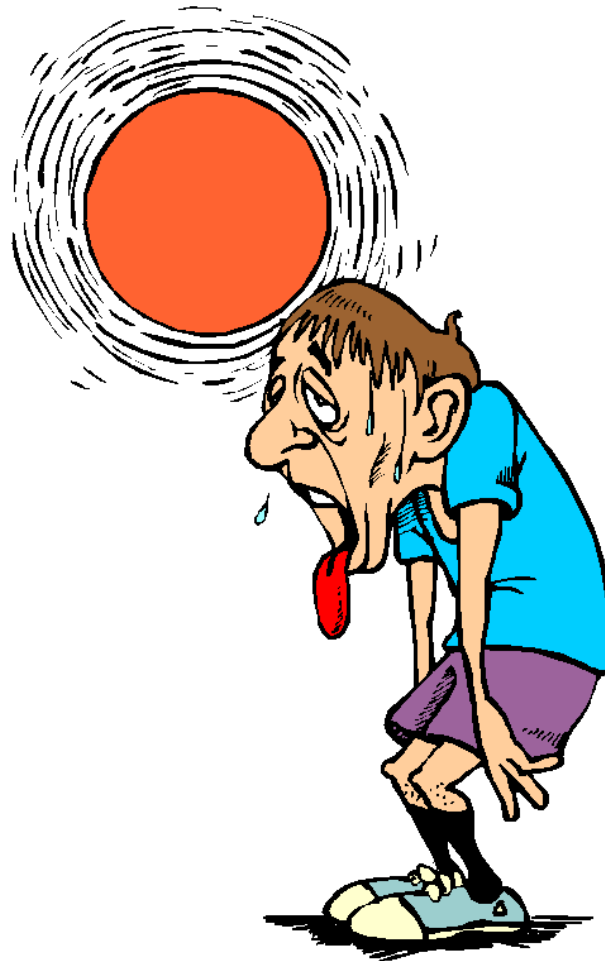


# MHAUS Hotline Stats 2014

## Location Episode Began



# Important MH Principles



# *Clinical News*

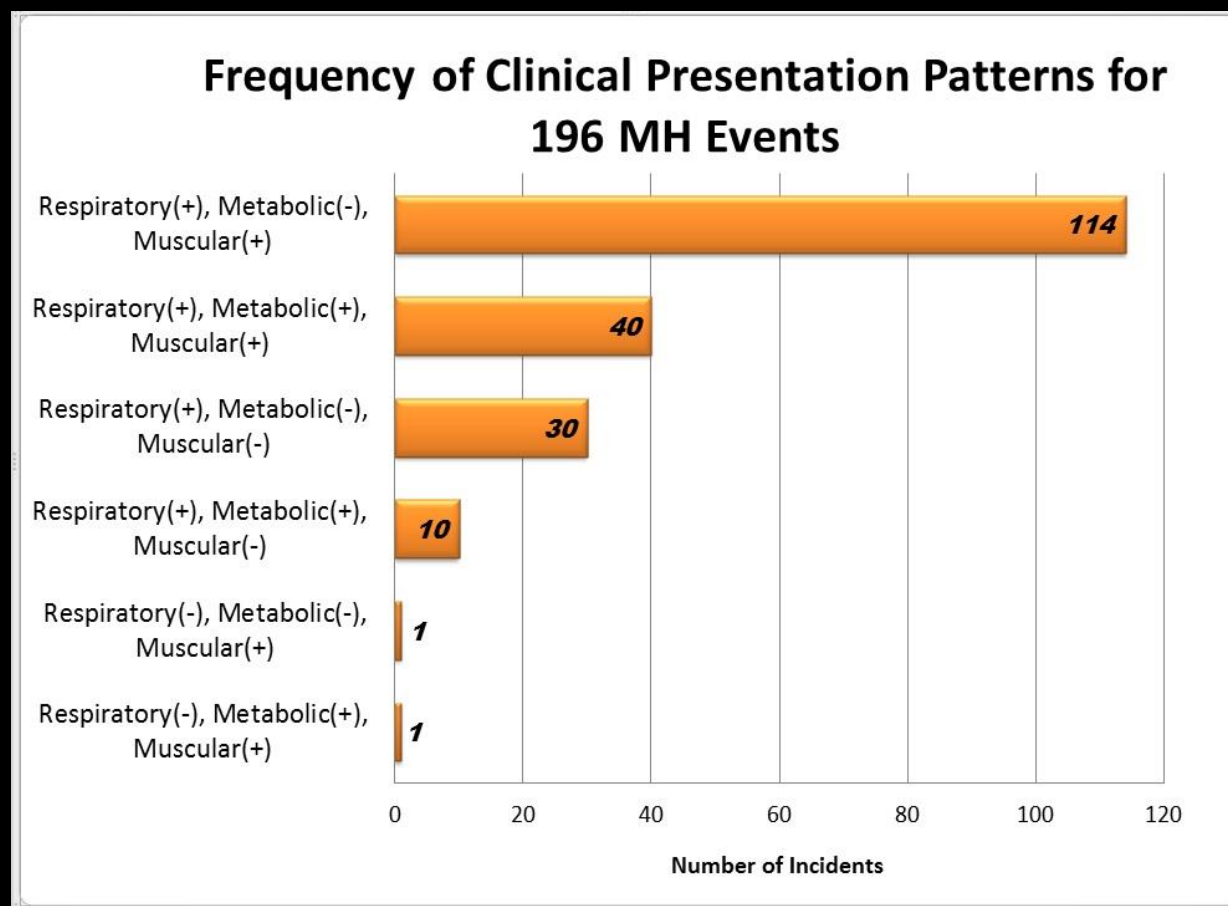
## **Clinical Presentation, Treatment, and Complications of Malignant Hyperthermia in North America from 1987 to 2006**

Table 1. Anesthetic Drug Triggers for 284 Malignant Hyperthermia Events

Anesthetic drug	Frequency	%
+Succinylcholine, –Volatile	2	0.7
+Succinylcholine, +Volatile	153	53.9
–Succinylcholine, +Volatile	128	45.1
–Succinylcholine, –Volatile <sup>a</sup>	1	0.4

Larach, Anesth Analg 2010;110:498-507

# Clinical Presentation, Treatment, and Complications of Malignant Hyperthermia in North America from 1987 to 2006



Larach, Anesth Analg 2010;110:498-507



# Malignant Hyperthermia in Canada: Characteristics of Index Anesthetics in 129 Malignant Hyperthermia Susceptible Probands

January 2014

Sheila Riazi, MSc, MD,\*† Marilyn Green Larach, MD, FAAP, ‡ Charles Hu, BSc,\*  
Duminda Wijeyesundera, MD, PhD,† Christine Massey, BSc,§ and Natalia Kraeva, PhD\*

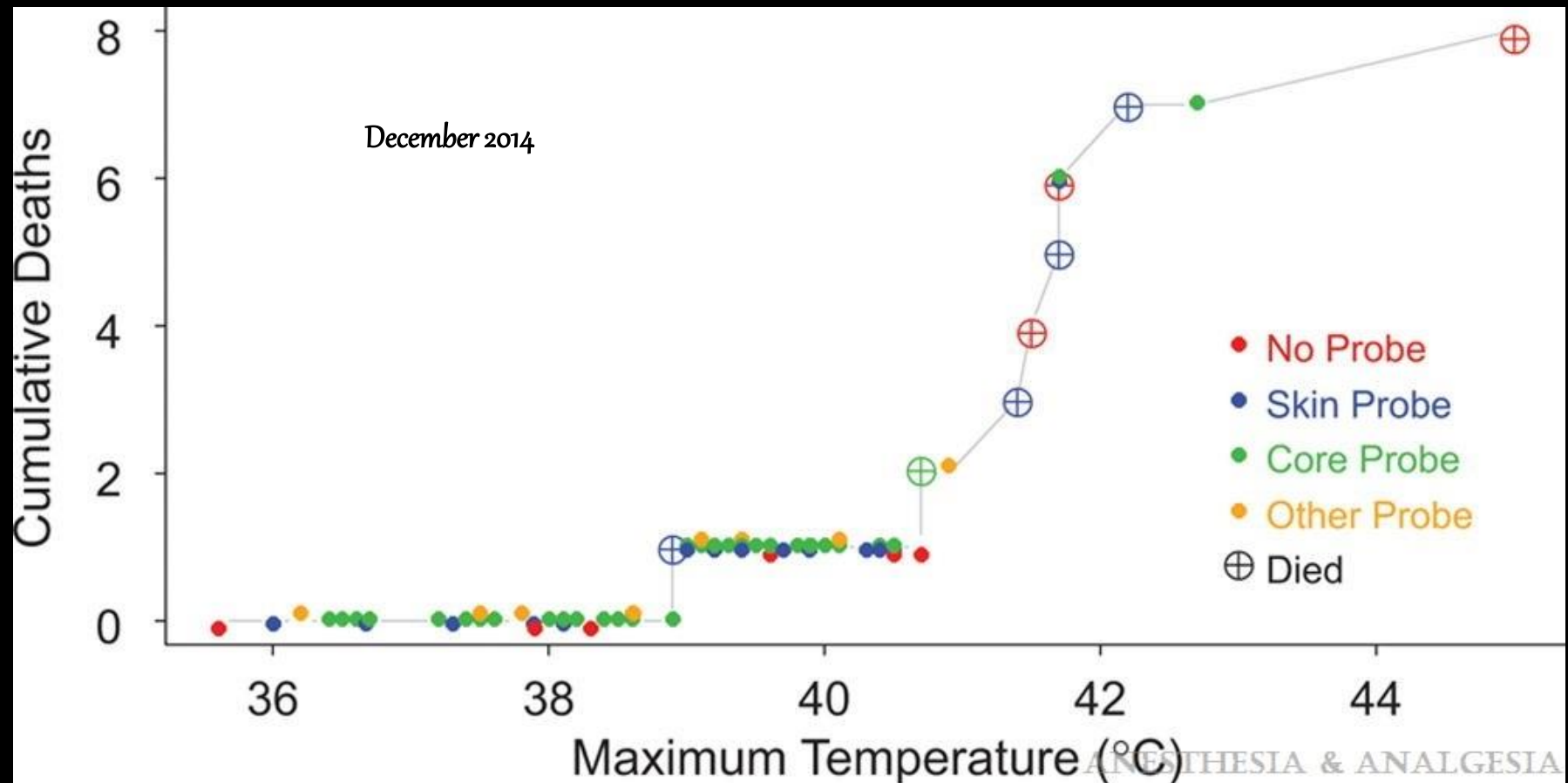


**Table 1. Characteristics of Index Adverse Anesthetics in 129 Malignant Hyperthermia-Susceptible Probands**

Demographics	
Male sex	79 (61.2%)
Age (y) at onset, median (range) [IQR]	23 (1–70) [10–33]
Caucasian	123 (95.3%)
Medical history	
Prior muscle symptoms	14 (10.9%)
Prior unremarkable anesthetics	17 (13.2%)
Prior unremarkable anesthetics (range) [IQR]	(1–5) [1–3]
Anesthetic triggers	
+Succinylcholine, –volatile, <i>n</i> (%) [95% CI]	20 (15.5%) [10–23]
+Succinylcholine, +volatile, <i>n</i> (%) [95% CI]	51 (39.5%) [31–49]
–Succinylcholine, +volatile, <i>n</i> (%) [95% CI]	58 (45.0%) [36–54]
–Succinylcholine, –volatile, <i>n</i> (%) [95% CI]	0 (0.0%) [0–3]

# Malignant Hyperthermia Deaths Related to Inadequate Temperature Monitoring, 2007–2012: A Report from The North American Malignant Hyperthermia Registry of the Malignant Hyperthermia Association of the United States

Marilyn Green Larach, MD, FAAP,\* Barbara W. Brandom, MD,\*† Gregory C. Allen, MD, FRCPC,‡  
Gerald A. Gronert, MD,§ and Erik B. Lehman, MS||



"All the News  
That's Fit to Print"

# The New York Times.

LATE CITY EDITION

Sunday with two Sunday Supplements  
Published daily, except on Sundays  
Subscription: Twelve Months, \$12.00  
Single Copies: 10 Cents

VOL. XCIV, No. 31,804

"The Big City"

NEW YORK, THURSDAY, AUGUST 6, 1948

THREE CENTS

## SHAFER, DEXTER, BRULL DECLARE WAR ON SKIN TEMP

*"If you don't  
monitor core  
temperature  
routinely, start  
today."*

### TRUMAN TO REPORT TO PEOPLE TONIGHT ON BIG 3 AND WAR

Half-hour speech by Radio to  
Cover a Wide Range of Prob-  
lems Facing the World

### HE SIGNS PEACE CHARTER

And Thus Makes This Country  
the First to Complete All  
Roosevelt Requirements

WASHINGTON, Aug. 6.—Pres.  
dents Truman will report to the  
country on the Russian matter  
and will also announce at 10  
P. M. that the Russian matter  
is a thing of the past.

The President's address  
character to the people will be  
the speech, which probably will  
be the shortest since the  
war, he is expected to say.  
The address will be the first  
since the war of the President.

Mr. Truman will be the  
first to do so since the war.  
He will be the first to do so  
since the war, he will be the  
first to do so since the war.

### Foreigners To Stay

WASHINGTON, Aug. 6.—The  
President's address to the  
country will be the first since  
the war, he is expected to say.  
The address will be the first  
since the war of the President.

The President's address  
to the country will be the first  
since the war, he is expected  
to say. The address will be  
the first since the war of the  
President.

The President's address  
to the country will be the first  
since the war, he is expected  
to say. The address will be  
the first since the war of the  
President.

The President's address  
to the country will be the first  
since the war, he is expected  
to say. The address will be  
the first since the war of the  
President.

The President's address  
to the country will be the first  
since the war, he is expected  
to say. The address will be  
the first since the war of the  
President.

The President's address  
to the country will be the first  
since the war, he is expected  
to say. The address will be  
the first since the war of the  
President.

COMPLETED

### RUSSIA AIDS ALLIES

Joins Pacific Struggle  
After Spurning Foe's  
Mediation Plea

### SEEKS EARLY PEACE

Molotov Reveals Move  
Three Months After  
Victory in Europe

WASHINGTON, Aug. 6.—Russia  
has joined the Pacific struggle  
after spurning the foe's  
mediation plea.

The Russian move was  
revealed by the Soviet  
Minister of Foreign Affairs,  
Vyacheslav Molotov, in a  
speech to the Soviet  
Parliament today.

THREE CENTS 

*“Do it right, with a continuous electronic measurement of core temperature.”*

The study had some of its own

County Council  
Executive Group  
Meeting 11



"All the News  
That's Fit to Print"

# The New York Times.

LATE CITY EDITION

Sunday with two Sunday Supplements  
Published daily, except on Sundays  
Subscription: Twelve Months, \$12.00  
Single Copies: 10 Cents

VOL. XCIV, No. 31,804

"The New York Times"

NEW YORK, THURSDAY, AUGUST 6, 1948

THREE CENTS

## SHAFER, DEXTER, BRULL DECLARE WAR ON SKIN TEMP

*"This is better than  
explaining to patients,  
parents, or the next of  
kin, why you chose to  
save \$6."*

### TRUMAN TO REPORT TO PEOPLE TONIGHT ON BIG 3 AND WAR

Half-hour speech by Radio to  
Cover a Wide Range of Prob-  
lems Facing the World

### HE SIGNS PEACE CHARTER

And Thus Makes This Country  
the First to Complete All  
Roosevelt Requirements

WASHINGTON, Aug. 6.—Pres-  
ident Truman will report to the  
country on the Russian counter-  
move when he makes a broadcast at 8  
P. M. He will also announce  
a three-point peace plan.

The Presidential address  
characteristic of him, and today  
the speech, which probably will  
last an hour, will be broadcast  
on the radio and will be heard  
by the millions of people who  
will be listening to it.

Mr. Truman's report on the  
peace plan will be the first of  
all other reports which will be  
made during the month.

### Foreigners To Stay

WASHINGTON, Aug. 6.—The  
management of the  
country's foreign  
policy will be  
the subject of the  
President's report to the  
country tonight. A  
statement by the  
President's press  
secretary today  
said that the  
President's report  
will be the first of  
all other reports  
which will be  
made during the  
month.

### TAMMANY LAST OF

County Council  
Executive Group's Action  
Meeting Packed

### COMPLETED RUSSIA AIDS ALLIES

Joins Pacific Struggle  
After Spurning Foe's  
Mediation Plea

### SEEKS EARLY PEACE

Molotov Reveals Move  
Three Months After  
Victory in Europe

By Associated Press  
MOSCOW, Aug. 6.—Russia  
has joined the Pacific struggle  
after spurning the  
United States' mediation  
plea.

The Russian move  
was announced today  
by the Soviet  
Foreign Minister,  
Vyacheslav Molotov.  
He said that the  
Soviet Union had  
accepted the  
United States' offer  
of mediation in the  
Pacific war.

# MH Mortality in ASC

The screenshot shows the MSNBC website interface. On the left is a sidebar with the 'TODAY' logo and a list of links: TODAY home, allDAY Blog, Participate, On the Trail, Photo features, Concert Series, Topics, Books, Entertainment, Fashion & Beauty, and Food & Wine. The main content area features a 'People' section with the headline 'Cheerleader's death highlights rare surgical risk' and the sub-headline 'High school senior dies after undergoing cosmetic breast surgery'. The article is by Mike Celizic, a TODAYShow.com contributor, and was updated on March 26, 2008. The text describes the death of Stephanie Kuleba, a cheerleader known as 'Sunshine', and includes a quote from a friend. To the right of the text is a video player showing a photo of Stephanie Kuleba with a 'Launch' button below it.

FEATURES **iVillage**  search MSNBC web

MSN Home | Mail **msn**

**TODAY**  
POWERED BY  
msnbc.com

TODAY home  
allDAY Blog  
Participate  
On the Trail  
Photo features  
Concert Series  
Topics  
Books  
Entertainment  
Fashion & Beauty  
Food & Wine

**People**

## Cheerleader's death highlights rare surgical risk

High school senior dies after undergoing cosmetic breast surgery

**By Mike Celizic**  
TODAYShow.com contributor  
updated 10:19 a.m. ET, Wed., March. 26, 2008

Stephanie Kuleba's friends called her "Sunshine" because that was the perfect nickname for the outgoing and bubbly girl who was everybody's friend, the cheerleader with the near-perfect grade-point average who was too nice and too perfect for anybody to resent.

"She was just the kind of girl that everyone loved," a friend, Dayna Mercer, told NBC News. "There was nothing bad about her."

But the 18-year-old high school senior, who was headed to college and then medical school, felt

**Video**

Launch

## Most MH deaths from hyperthermia!



# Heat Stroke and MH

- 12 year old child has acute MH in OR
- CHCT shows MH susceptibility
- 8 mos later: dies after football practice: T 108 F
- RYR-1 mutation detected in pt and relatives



# Awake MH?

## Identical *de novo* Mutation in the Type 1 Ryanodine Receptor Gene Associated with Fatal, Stress-induced Malignant Hyperthermia in Two Unrelated Families

Linda Groom, B.Sc.,\* Sheila M. Muldoon, M.D.,† Zhen Zhi Tang, Ph.D.,‡  
Barbara W. Brandom, M.D.,§ Munkhuu Bayarsaikhan, Ph.D.,|| Said Bina, Ph.D.,#  
Hee-Suk Lee, M.D.,\*\* Xing Qiu, Ph.D.,†† Nyamkhishig Sambughin, Ph.D.,‡‡  
Robert T. Dirksen, Ph.D.§§

***Anesthesiology 2011; 115:938***

***7 reported cases***







To protect private  
Patient Information

Only (1) family allowed at  
the desk at a time

Last name appears on monitor  
when prescription is ready

Thank You.

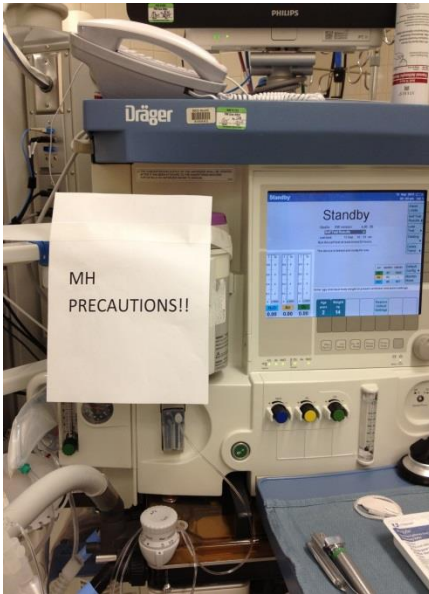
# Anesthesia for Known MH Patients

- Non-triggering technique
- Carefully monitor etCO<sub>2</sub>
- Normal discharge criteria
- ASC should be adjacent to hospital



# Preparation of Anesthesia Workstations for MH Susceptible Patients

## 4 alternatives:



# ASC Anesthesia for Known MH Patients



*Vapor-Clean, Dynasthetics*







# Immediate Treatment of MH

## Important Steps

- Mobilize personnel
- **DANTROLENE**
- Arrange transfer
- Continue active treatment
- **800-MH-HYPER (644-9737)**



# RYANODEX

- Eagle Pharmaceuticals
- **250 mg/5 mL**
- Decreased time to preparation
- Less volume load
- **1** successfully treated case!
- **More data next year!**



# RYANODEX

- Contains subclinical amts of mannitol
- **Why is mannitol in older versions of dantrolene?**
- MHAUS changed website guidelines on treatment of myoglobinuria





# Why Joan Rivers Matters



# Why Joan Rivers Matters



# Dantrolene & Ca Channel Blockers

- CCBs probably detrimental during dantrolene admin
- **Never withhold dantrolene in MH pts on maintenance CCBs.**
- MHAUS has retracted website statement



# Malignant Hyperthermia

MHAUS Hotline 1-800-644-9737

Surgery Centers: 911 and transport arrangements

## Anesthesiologist

1. CALL FOR HELP!
2. Stop triggering agents and place charcoal filters in circuit
3. Hyperventilate with 100% O<sub>2</sub> @ 10L/min
4. Start TIVA
5. Give Ryanodex 2.5 mg/kg IV
6. Aggressive IV hydration
7. Active cooling if T > 38C
  - Bair Hugger to cool
  - Cold IVF 0.9% NS
  - Ice packs to head, groin, axillae
  - Cold lavage, cavity irrigation
8. Place lines
  - Arterial line
  - Foley catheter
  - NG tube
9. Obtain Labs
  - ABG, glucose, CK, lactate, electrolytes, CBC, serum myoglobin, coags, D-dimer, fibrinogen
  - Urine myoglobin

## Nursing

1. Call Anesthesia techs for MH equipment
2. Obtain:
  - Supplies for wound irrigation and closure
  - Urinary catheter tray
  - Ice packs

## Anesthesia Techs

1. Bring:
  - MH cart
  - Defibrillator
  - ISTAT, glucometer
  - Arterial and central line supplies
2. Prepare cold 0.9% NS IVF

## Surgeon

1. Irrigate cavity with cold fluid
2. Stop procedure when appropriate
3. Place urinary catheter
4. Assist with line placement
5. Call ICU to arrange bed

**IN EVENT OF PVCs, DYSRHYTHMIA, OR ARREST  
ASSUME HYPERKALEMIA**

## RYANODEX

- Each vial contains 250mg
- Dissolve each vial with 5 mL **sterile water**
- Give 2.5mg/kg IV bolus
- Repeat dose if signs of MH persist (up to 10mg/kg)
- Ca Channel blockers are contraindicated after administration of Dantrolene!
- Dantrolene causes potentiation of NMJ

## Treatment Goals

1. HD Stability
2. Temp <38 C
  - Stop active cooling at 38C
3. Prevent Rhabdomyolysis
  - Aggressive IV hydration with 0.9% NS
  - Maintain urine >2ml/kg/hr
4. Correction of Acidosis and Hyperkalemia
  - Hyperventilation
  - NaHCO<sub>3</sub> 1-2 mEq/kg
  - CaCl or Ca Gluconate
  - Insulin 0.1U/kg with D50







*Malignant Hyperthermia Association  
of the United States*

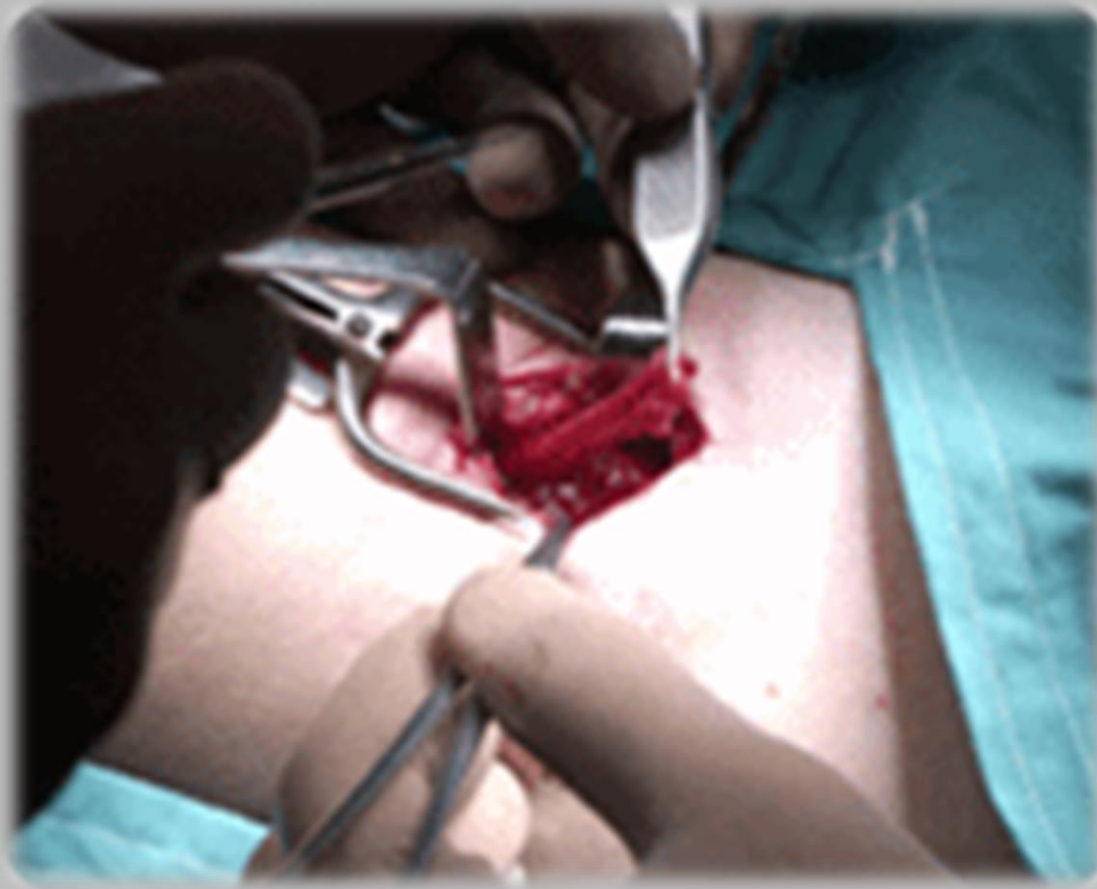
# **MHAUS GUIDELINES**

**Testing for Malignant  
Hyperthermia (MH)  
Susceptibility:**

**How do I counsel  
my patients?**



# Muscle Contracture Testing (CHCT)



# **CHCT Testing, U.S. and Canada**

***University of Minnesota  
Minneapolis, MN  
Paul A. Iaizzo, PhD  
(612) 624-7912 or -3959***

***Uniformed Services University  
of the Health Sciences  
Bethesda, MD  
(Military & Civilian)  
Sheila M. Muldoon, MD***

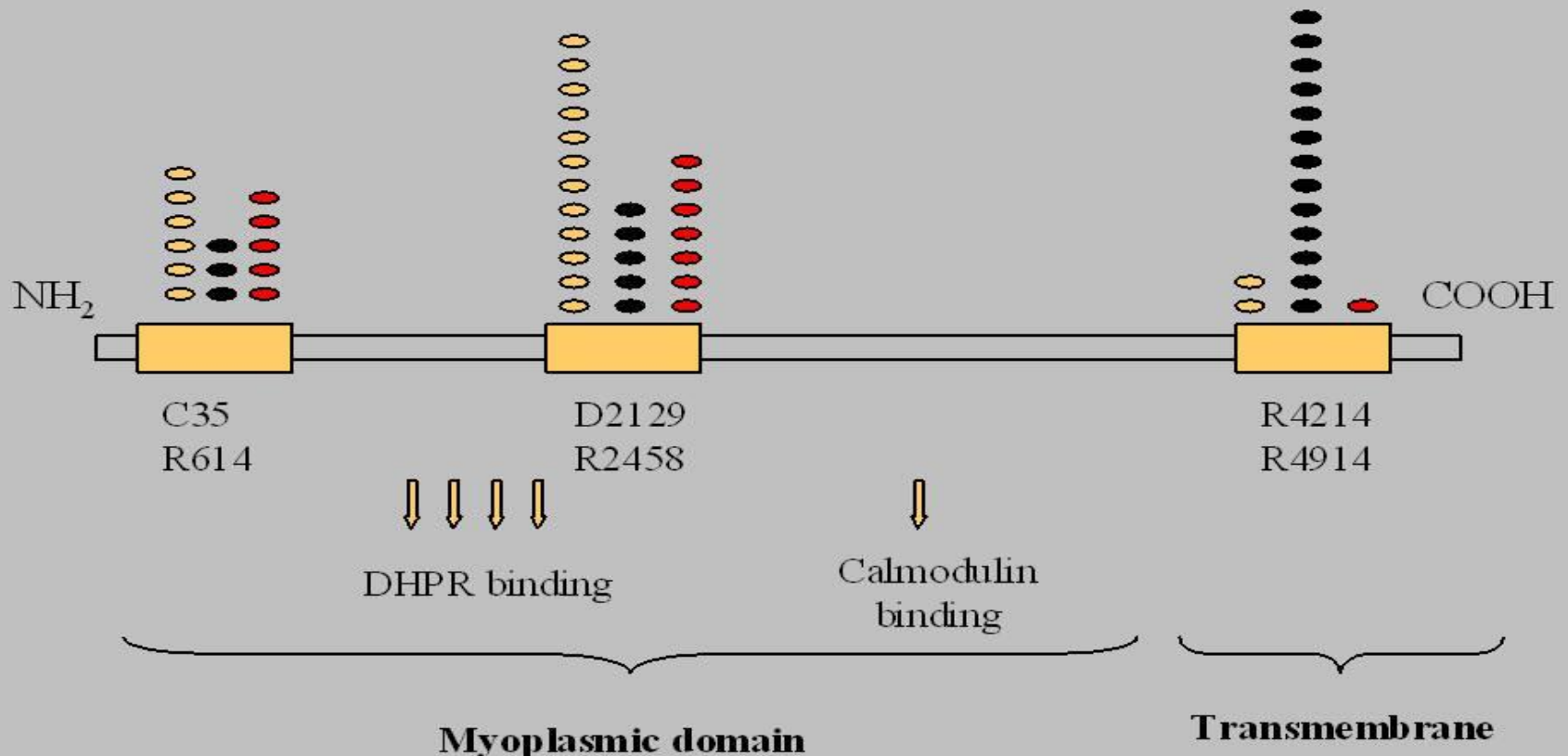
***University of California  
Davis, CA  
Timothy Tautz, MD***

***Wake Forest University  
Winston-Salem, NC  
Joseph R. Tobin, MD***

***Toronto General Hospital  
Toronto, Ontario  
Julian Loke, MD, FRCPC***

# Genetic Testing: RYR1 Gene Sequencing

RYR1: gene structure and mutational spots







# The next Jeter

**BOMBERS' BIG TRADE: SPORTS**



**European MH  
Group Finds NEW  
MUTATIONS!**

# 36 MH-Causing Mutations!

UNIVERSITÄT BASEL

European Malignant Hyperthermia Group **EMHG**

[HOME](#) [SITEMAP](#) [CONTACT](#) [LOGIN](#)

[EMHG](#) [MH UNITS](#) [DOCUMENTS](#) [GENETICS](#) [NEWS & EVENTS](#) [HONORARY MEMBERS](#)

## European Malignant Hyperthermia Group (EMHG)



Correspondence about the EMHG to:  
Professor PM Hopkins  
Secretary of the EMHG  
Leeds Institute of Molecular Medicine  
St James's University Hospital  
GB-LEEDS  
LS9 7TF

E-Mail: [P.M.Hopkins-at-leeds.ac.uk](mailto:P.M.Hopkins-at-leeds.ac.uk)

Correspondence about this website see  
[contacts form](#).

### EVENTS

11.06.2015 to 13.06.2015  
[2015 Annual Meeting: Lille](#)  
26.05.2016 to 28.05.2016  
[2016 Annual Meeting: Ulm \(Dates  
to be confirmed\)](#)

### NEWS

**12.12.2014**  
New diagnostic mutations  
**19.08.2014**  
33rd annual meeting abstracts on BMC Anesthesiology  
**12.06.2014**  
33rd EMHG Meeting in Würzburg, Germany  
**16.12.2013**  
Dr. Mary Lehane , FFARCSI  
**10.07.2013**  
Speaking about MH => here are some slides for you

### QUICKLINKS

[EMHG](#)  
[MH Units](#)  
[Documents](#)  
[Genetics](#)

# MALIGNANT HYPERTHERMIA SUSCEPTIBILITY NEXTGEN SEQUENCING (NGS) PANEL

Clinical Features and Genetics

Methods and Pricing

How to Order

Additional Information

## TEST METHODS

- ▶ [NEXTGEN SEQUENCING](#)
- ▶ [DELETION/DUPLICATION TESTING VIA ARRAY COMPARATIVE GENOMIC HYBRIDIZATION](#)

## NEXTGEN SEQUENCING

Test Number	Test	Price	CPT Code(s)
1383	NextGen Sequencing (3 genes)	\$1,690	81479 (x2), 81408

In addition, Targeted Familial Mutation testing via Sanger sequencing is available for any gene in the panel:

Test Number	Test	Price	CPT Code
100	Targeted Familial Mutations - Single Exon Sequencing	\$250	81479
200	Targeted Familial Mutations - Double Exon Sequencing	\$370	81479
300	Targeted Familial Mutations - Triple Exon Sequencing	\$440	81479



# Malignant Hyperthermia

## "Hot Off the Press"



*Ron Litman*

[litmanr@email.chop.edu](mailto:litmanr@email.chop.edu)