

Validation and extension of Mammillary models for predicting the probability of decompression sickness in scuba diving

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TABLE 1. GOODNESS-OF-FIT TO THE CALIBRATION DATASET (1)

MODEL	# Fitted parameters	# Degrees of freedom	Chi-squared	Probability(2)
2CP	4	111	125.1	.8292
2CM	3	112	111.3	.5005
3CM	4	111	93.7	.1182
4CM	5	110	63.4	.0001

(1) THIS CONSISTED OF A MIX OF ALL THE QUALITY AIR SINGLE SQUARE PROFILES THAT EXIST (725 SINGLE DIVES) TOGETHER WITH ALL THE MIXED-PROFILE DATASETS (ALL AIR) THAT WERE USED TO CALIBRATE THE PADI "RDP" (1434 SINGLE DIVES). TOTAL # SINGLE DIVES = 2159; OVERALL HIT RATE (BASED ON SINGLE DIVES) = 3.7%.

(2) THIS IS THE PROBABILITY THAT THE FIT (OR EQUIVALENTLY, THE CALCULATED CHI-SQUARED) COULD HAVE BEEN OBTAINED BY CHANCE.

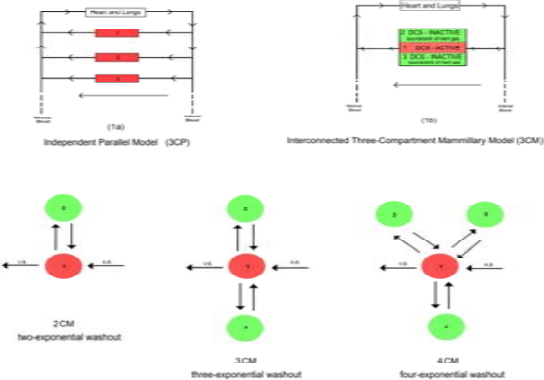
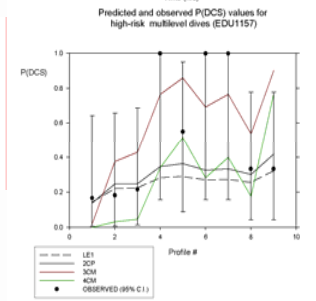
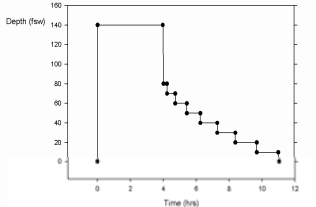
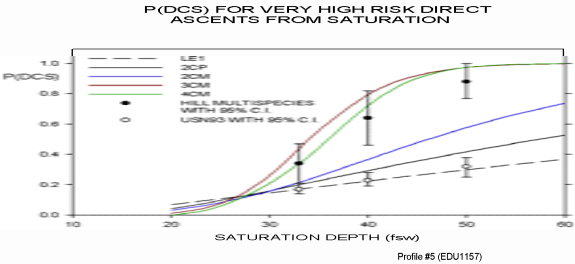


TABLE 2. ACCURACY OF MODEL-PREDICTED P(DCS) VALUES FOR RECREATIONAL DIVESET OF MARRONI *et al.* (181 REPETITIVE DIVES, 0 HITS, WITH DIFFERENT NUMBERS OF STOPS AND ASCENT RATES).

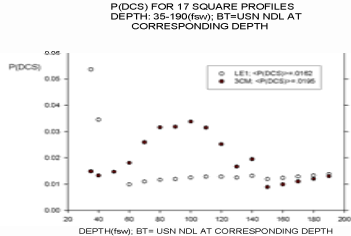
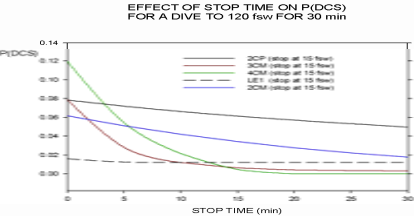
MODEL	HIT RATE % (PREDICTED)	Total # HITS (1) (PREDICTED)	Chi-squared(2)	Probability(3)
LE1	0.60	1.09	2.20	.0256 (<.05)
2CP	2.70	4.89	9.91	.7285 (>.05)
2CM	0.70	1.26	2.53	.0397 (<.05)
3CM	0.33**	0.59	1.18	.0031 (<.05)
4CM	0.0001**	0.00021	0.00042	0.0 (<.05)

** COMPARED WITH THE PDE HIT RATE OF $\approx .032\%$, THESE 3CM AND 4CM PREDICTED HIT RATES SEEM TO BRACKET THE P(DCS) OF THE RECREATIONAL REGIME WITH 3CM TOO HIGH AND 4CM TOO LOW.

(1) TOTAL # HITS (PREDICTED BY MODEL "J") = $\sum_{i=1}^N P_j(DCS)_i \cdot ND_i$. THERE WERE 8 DIVESETS WITH 2 DIVES/DIVASET.

(2) BASED OF EIGHT DEGREES OF FREEDOM (FROM EIGHT DIVESETS).

(3) PROBABILITY THAT THE CALCULATED CHI-SQUARED COULD HAVE BEEN OBTAINED BY CHANCE.



Conclusions

- 1.The 3CM and 4CM models each provide better fits to the calibration data than do the 2CM and 2CP models.
- 2.The 3CM and 4CM models each extrapolate both to the very high-risk saturation and to the very low-risk recreational regimes more accurately than do the 2CM model and the independent parallel 2CP and LE1 models.
- 3.The greater initial rate of risk abatement during safety or decompression stops predicted by the 3CM and 4CM models is due to their relatively rapid initial washout rate.
- 4.The P(DCS) calculations with the mammillary models can be done accurately and very rapidly - typically (.001-.01) seconds/profile on a standard (2.8 GHz) microprocessor.
- 5.The 3CM model is more conservative than the 4CM model in its prediction of the degree of risk-abatement on doing safety/decompression stops. Future studies involving the very large PDE database are planned to establish which of these two models is the most accurate.