



Improving Prediction for DISSUB Rescue Using 70 kg Swine Dropout Decompression from 30-50 fsw

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AGENDA

- Background
- Type I DCS
- Type II DCS
- Comparison of Human and Swine
- Summary/Recommendations

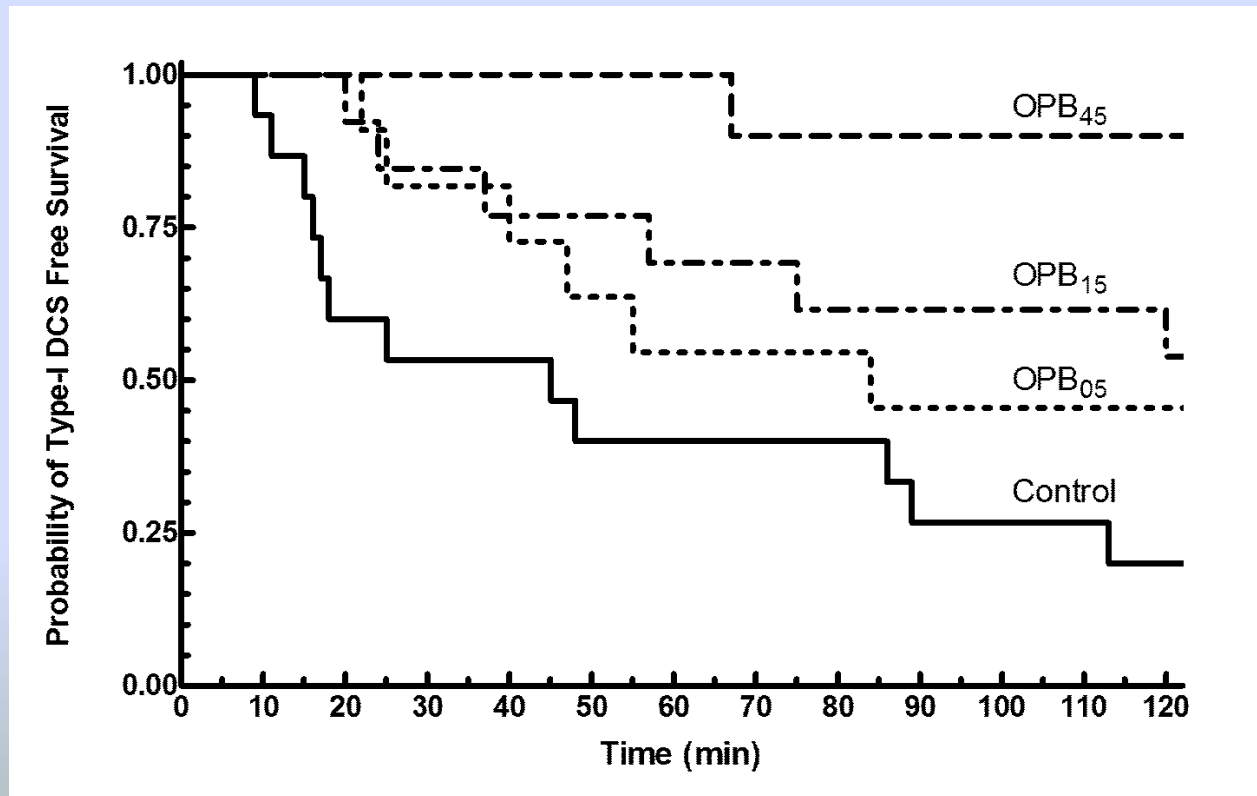


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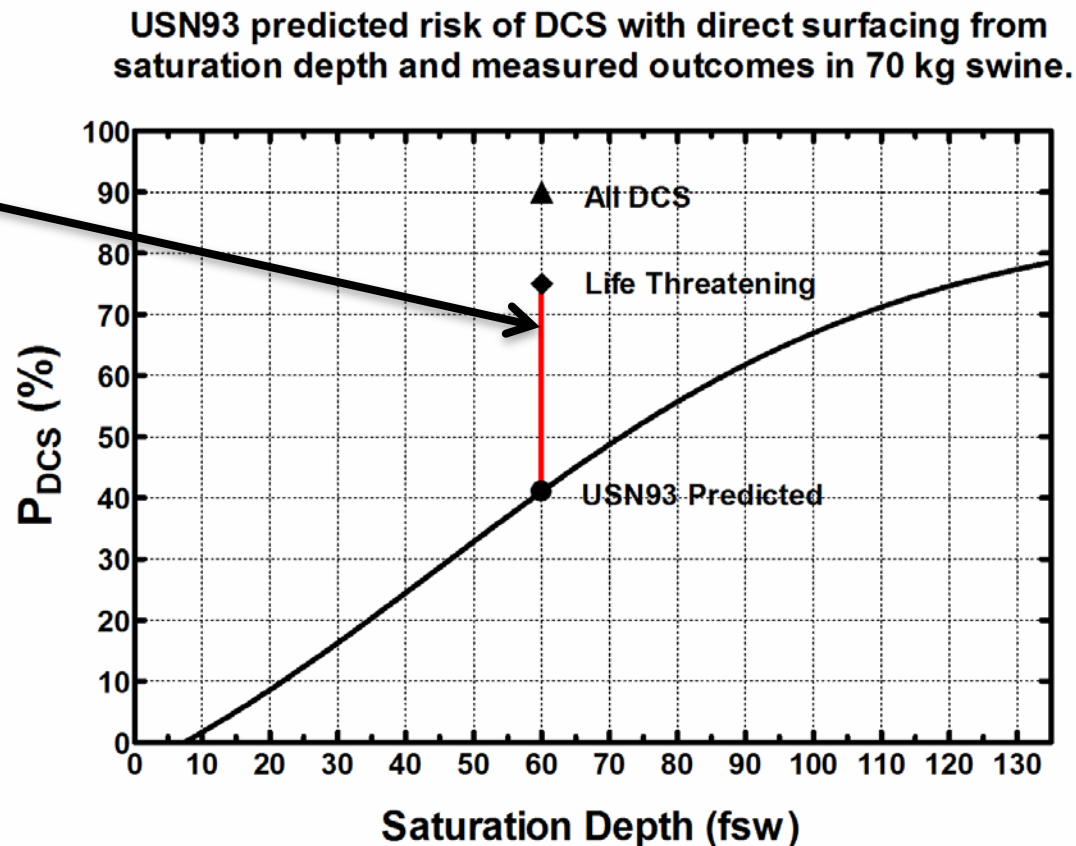
45 minutes of O₂ prebreathe at depth reduced Type I DCS after saturation at 60 fsw¹ in 70 kg swine model



¹ Mahon et al. J Appl Physiol 106: 1459–1463, 2009.

Observed DCS in swine is twice the
predicted DCS incidence in humans at
60 fsw saturation

70 kg swine



OBJECTIVES

Explore dropout decompression in the 70 kg swine from 30 to 50 fsw saturation. Provide an evidence-based tool for triage and therapy in DISSUB rescue/escape.

Specific Aims:

- Dropout decompression in the 70 kg swine from 50, 40 and 30 fsw air saturation
- Comparison of 70 kg swine results to existing human data from 25.5 – 33.0 fsw

METHODS

Saturation: 22 hours on air at 30, 40 or 50 fsw

Subjects: Castrated Male swine, 70 kg
randomized to depth in pairs

Target: 20 animals per depth

Ascent rate: 0.91 ATA (30 fsw/min)

Post surface: 2 hour observation period



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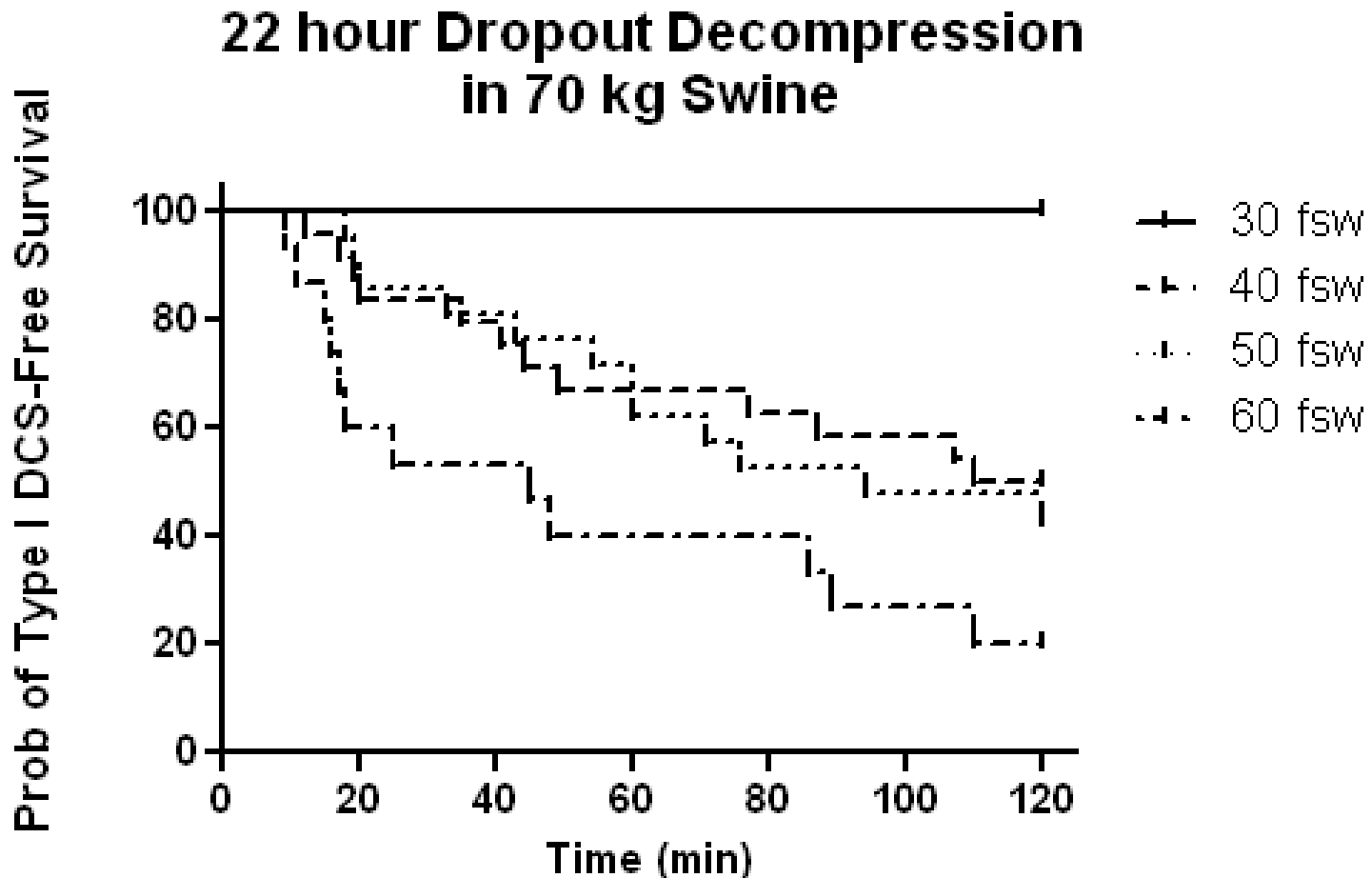
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Swine: 0% DCS incidence at 30 fsw

Group	n	Mean Weight (kg)	SEmwt	Type I DCS
30 fsw	18	67.81	0.9049	0 (0%)
40 fsw	24	67.71	0.4880	14 (58%)
50 fsw	21	68.24	0.7918	13 (62%)
60 fsw	15	69.49	0.8302	13 (87%)

The F-statistic for the ANOVA of the mean weights corresponded to a P value of 0.3781, indicating no difference between groups

Statistically significant difference in Type I DCS Survival by depth





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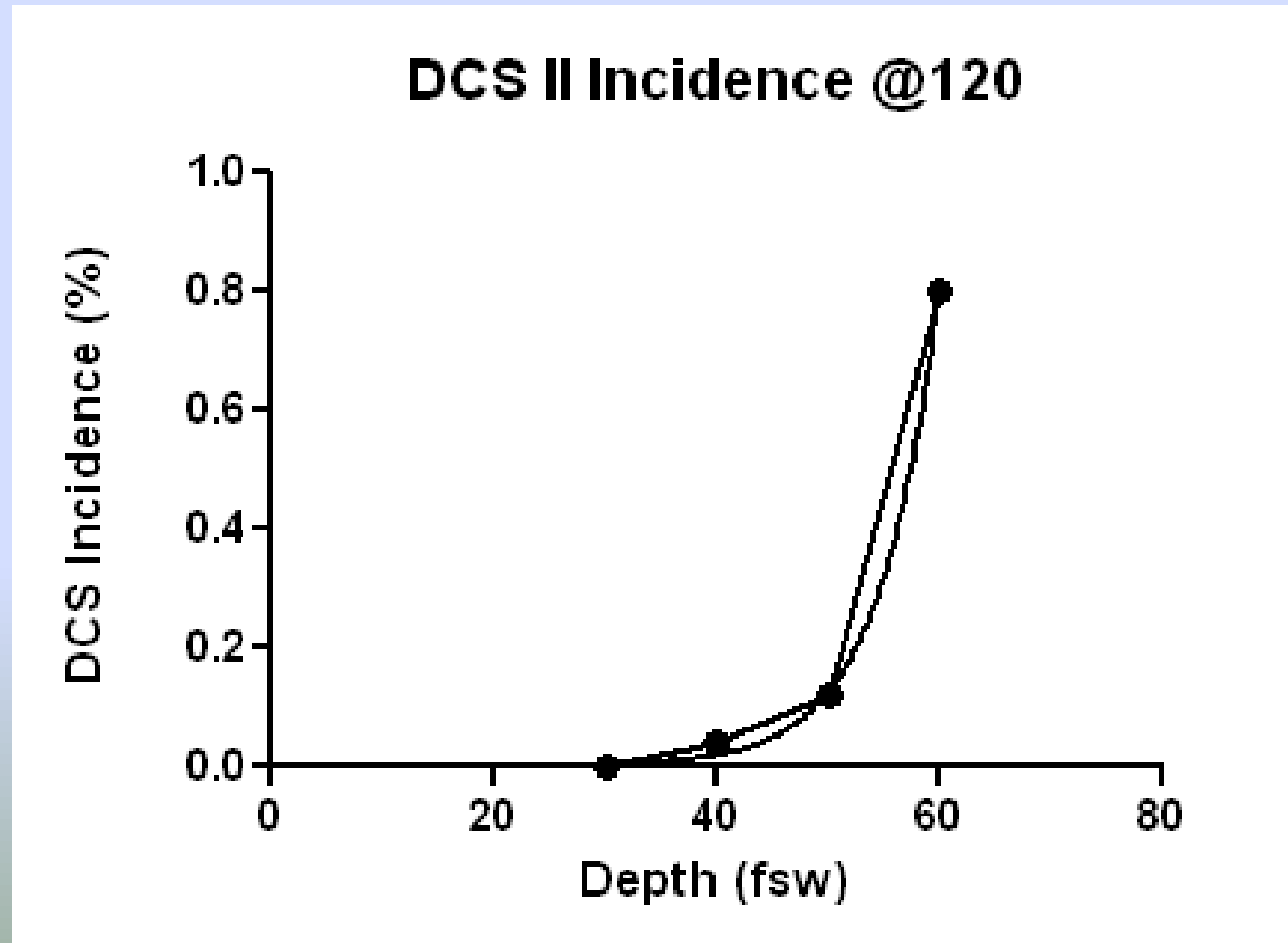
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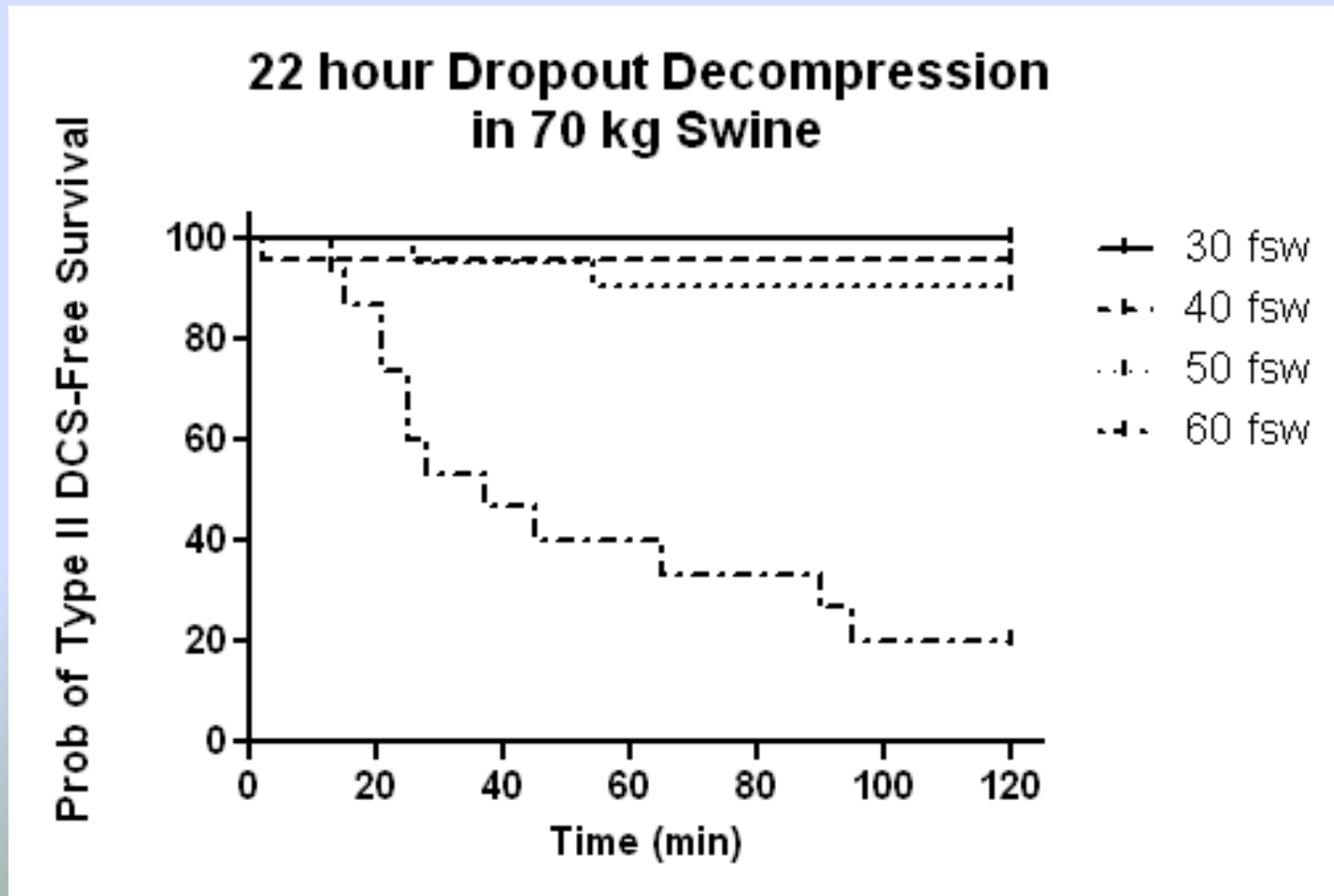
Group	n	Type I DCS	Type II DCS
30 fsw	18	0 (0%)	0 (0%)
40 fsw	24	14 (58%)	1 (4%)
50 fsw	21	13 (62%)	3 (14%)
60 fsw	15	13 (87%)	12 (73%)

The F-statistic for the ANOVA of the mean weights corresponded to a P value of 0.3781, indicating no difference between groups

Type II DCS Incidence increases exponentially from 30 to 60 fsw in Swine



Statistically significant difference in Type II DCS Survival by depth

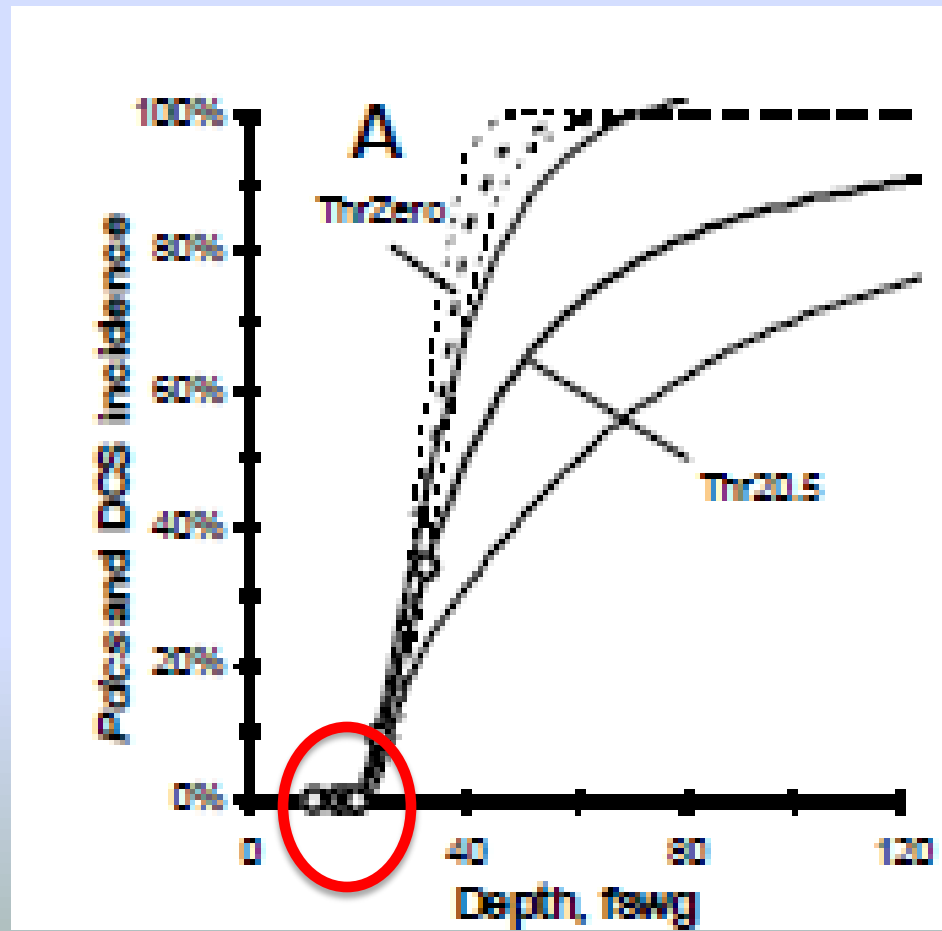




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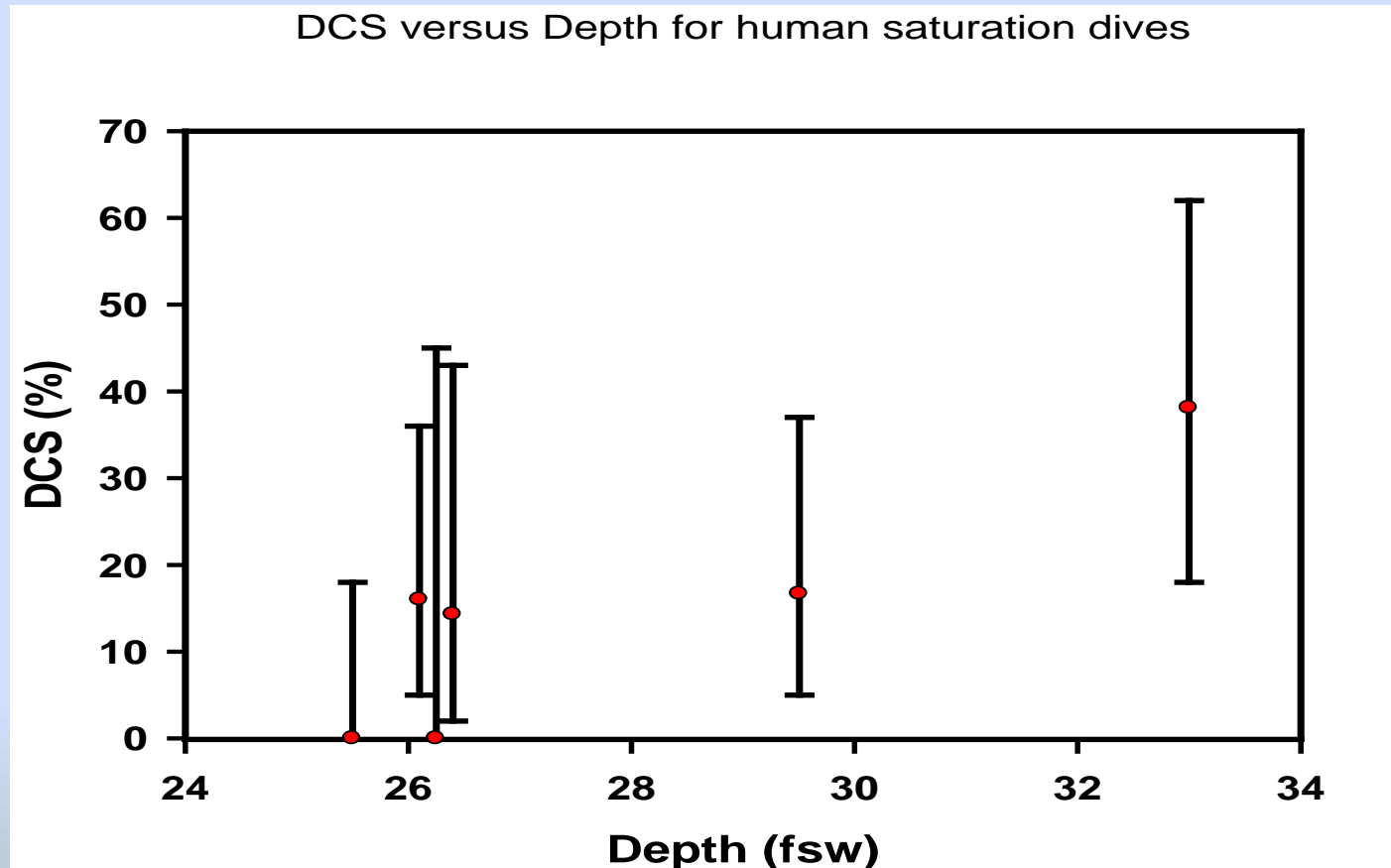
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No incidence of human DCS from dropout decompression of 20 fsw or shallower ³



³Van Liew, Flynn UHM 2005, Vol. 32, No. 6 pp409-419.

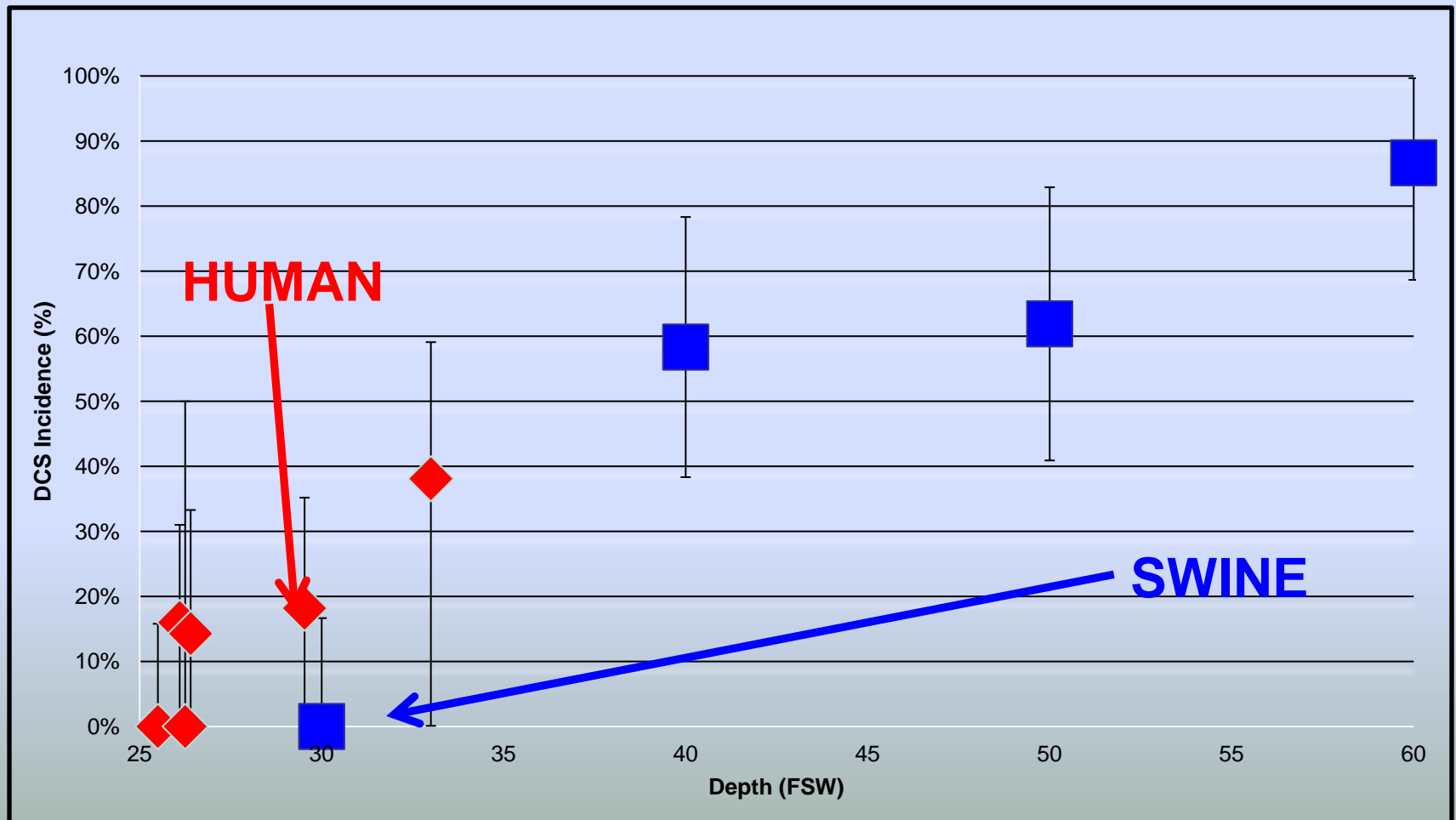
Combined human data from saturation at 25-33 fsw, DCS incidence 17%²



Graphical display of human saturation dropout DCS cases to include “marginal.” Red dots are actual numbers with confidence intervals displayed by bars.

² Temple et al. NMRC 99-02 (Vol. I) May 1999.

Observed DCS incidence from dropout decompression less in swine than in humans at 30 fsw



Observed 70 kg swine DCS incidence more closely matches the Van Liew model

Model/Data	Human observed DCS incidence	70 kg swine observed DCS incidence	Van Liew UHMS 2005 Predicted DCS incidence	USN 93 Predicted DCS incidence
20 fsw	0%		0%	9%
30 fsw	17%	0%	17%	17%
40 fsw		58%	50%	25%
50 fsw		62%	60%	33%
60 fsw		87%	72%	41%

Subjective self-reporting is a possible contribution to DCS incidence differences at 30 fsw in swine and humans

- Similarities:
 - Objective measures: cutis, joint pain, cardiopulmonary, neurologic weakness
- Differences:
 - Subjective self-reporting (fatigue and diffuse muscular aches)



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SUMMARY

- There was no DCS for swine at 30 fsw compared to 17%-23% incidence from historical human data at 25.5-33 fsw saturation; n=106 dives, 18 DCS (17%) plus 24 “marginal cases” (22%).
- The two-fold observed incidence in DCS in swine at 60 fsw is even more concerning for the drastic increase in severe Type II DCS (0% to 80% from 30 to 60 fsw)
- If 70kg swine are indeed more resistant to DCS at 30 fsw as compared to humans, it is reasonable that the same would hold true at 40, 50 and 60 fsw.

CONCLUSIONS

- USN 93 prediction model appears to under predict human DCS incidence from saturation dropout as compared to the 70 kg swine model
- The 70 kg swine model appears to more closely follow the Van Liew/Flynn model (UHMS 2005)
- Triage planning for DISSUB scenarios should consider the possibility of a large increase in DCS (Type I) incidence with a change in saturation dropout depth from 30 to 40 fsw and a large increase in severe DCS (Type II) with a change from 50 to 60 fsw.



Acknowledgements

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QUESTIONS ?