FY14 High Performance EVA Glove (HPEG) Collaboration: Glove Injury Data Mining Effort

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Presentation Overview

- Background/Objectives
- Methodology
- Descriptive Statistics Highlights
- Predictive Statistics Highlights
- Discussion
- Future Work

Background/Objectives

- Glove injuries, both anecdotal and recorded, have been reported during training and EVA persistently through NASA's history regardless of mission or glove model
- Theories as to causation are common (e.g., EVA tasks or EVA gloves) but are often lacking in what exactly needs changing
- The High Performance EVA Glove (HPEG) element was undertaken to meet three goals:
  - Improve EVA gloved performance
  - Increase EVA glove durability
  - Reduce EVA gloved injury levels
- Prior to this study, previous statistical analysis evaluated onycholysis in the context of crew anthropometry only (Opperman et al 2010)
- Task undertaken for FY13-14 to fully analyze all injuries and available variables to the extent possible with the objective to determine engineering or operational controls to reduce gloved injury

Methodology

- Multi-disciplinary NASA analysis team included members from ergonomics, space suit engineering, EVA physiology, and epidemiology / public health
- Collect all known injury records, combine and correlate with as many injury-related variables as possible
  - Anthropometry and individual factors
  - Sizing (glove and suit)
  - Glove model
  - Crew training history and density (frequency)
  - Specifics surrounding injury event
  - Others (countermeasures, etc.)
- Provide descriptive and predictive statistical analysis of results

Crew Record Distribution Across Datasets

- 1981-2010
- U.S. crew
- EMU
- Shuttle, ISS, WETF, NBL
- Anthropometric data available

179 crewmembers

179 trained

44 reported injury (17 onycholysis)

96 flew EVA

50 reported injury (4 onycholysis)

12,026 exposures

322 EVA — 96 had injury; 4 onycholysis

11,704 training — 88 had injury; 27 onycholysis

4000 Series gloves: 5760

Phase VI gloves: 5451

Descriptive Statistics Results–Highlights

Training vs. EVA Injury Types

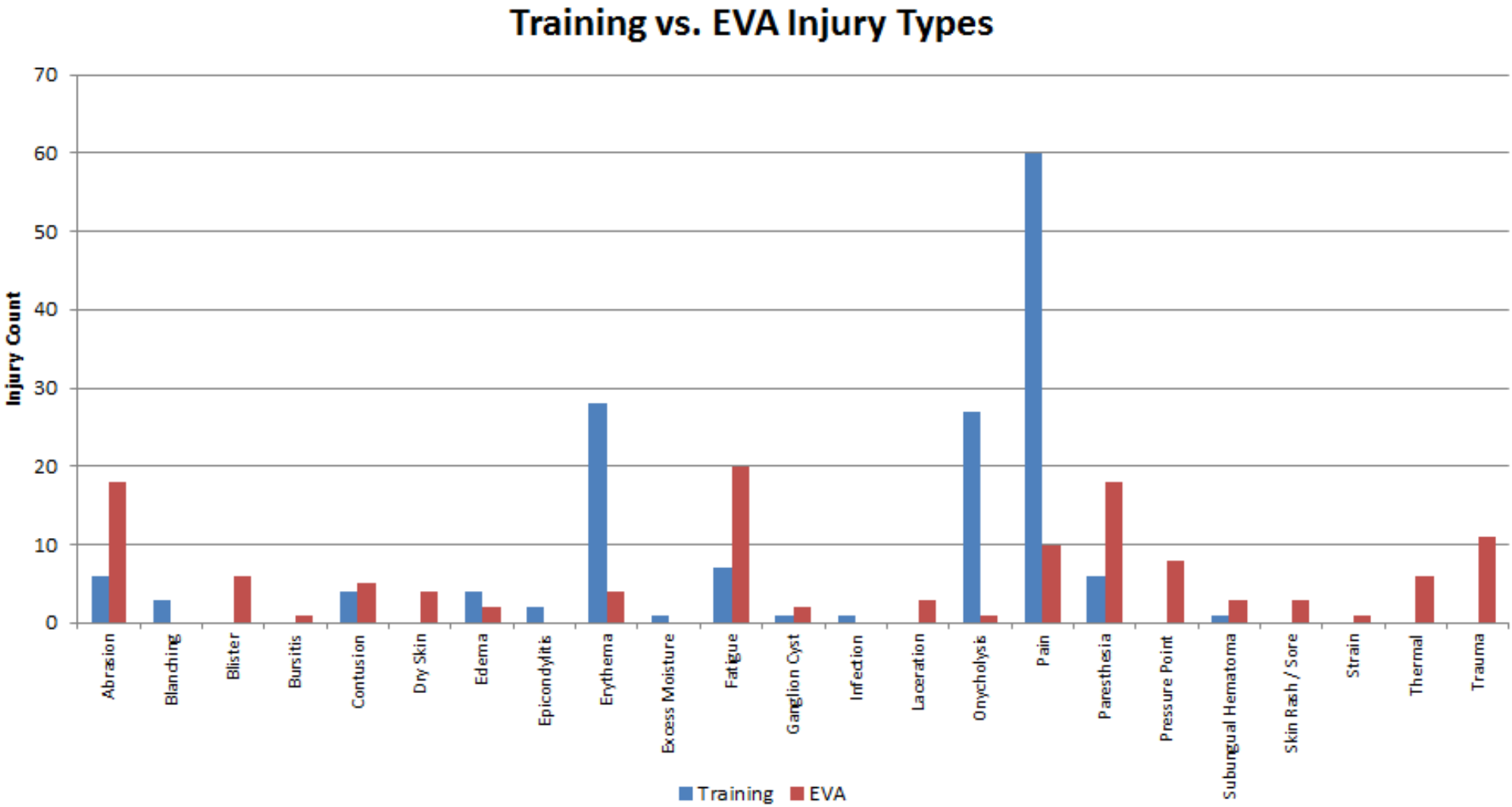
Training Injuries

Injury Type	Count
Pain	60
Erythema	28
Onycholysis	27
Fatigue	7
Paresthesia	6
Abrasion	6
Contusion	4
Edema	4
Blanching	3
Epicondylitis	2
Subungual Hematoma	1
Ganglion Cyst	1
Infection	1
Excess Moisture	1
Total Injury Count	**151**

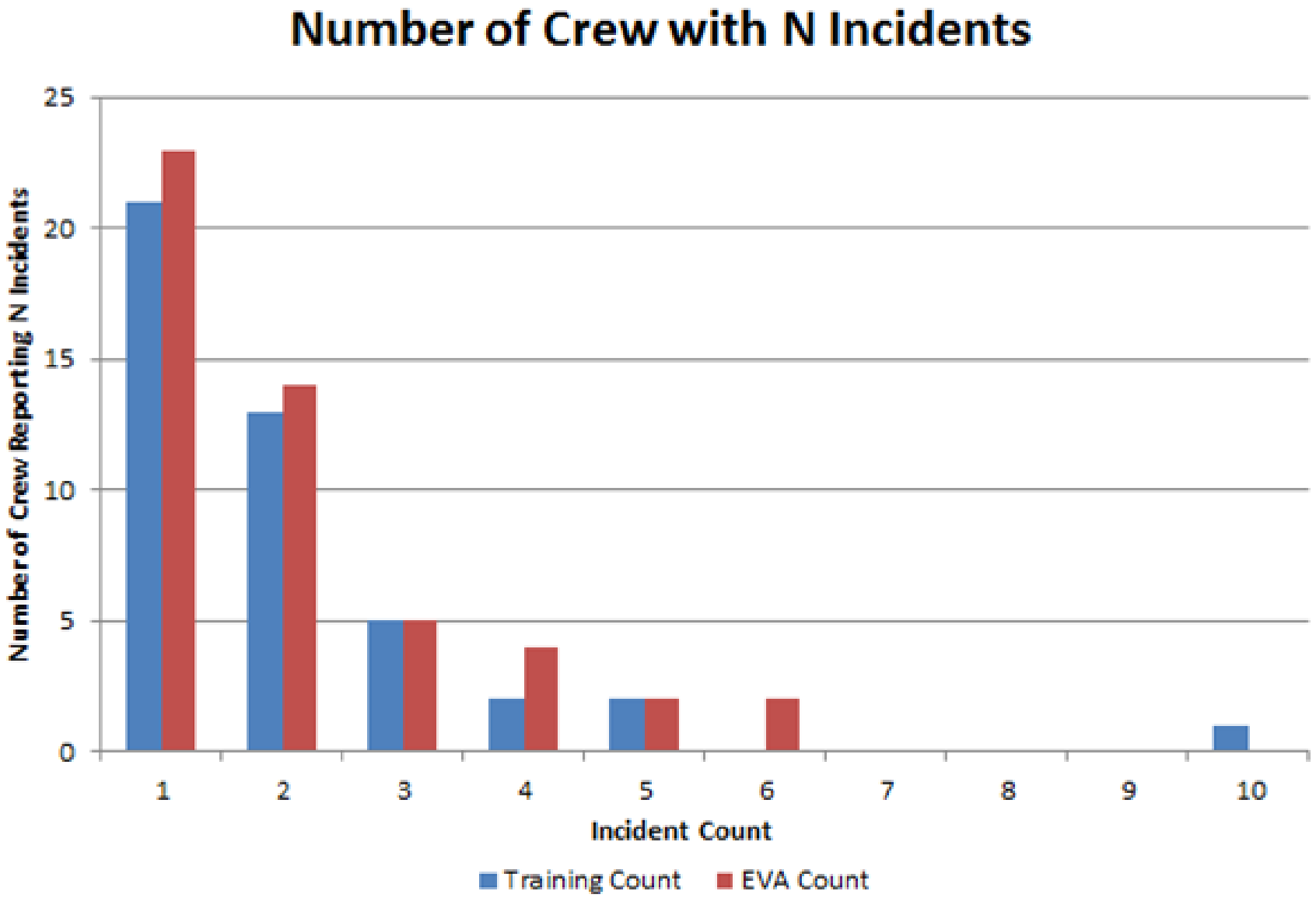
EVA Injuries

Injury Type	Count
Fatigue	20
Abrasion	18
Paresthesia	18
Trauma	11
Pain	10
Pressure Point	8
Thermal	6
Blister	6
Contusion	5
Erythema	4
Dry Skin	4
Laceration	3
Skin Rash / Sore	3
Subungual Hematoma	3
Ganglion Cyst	2
Edema	2
Onycholysis	1
Bursitis	1
Strain	1
Total	**126**

Training vs. EVA Injury Types (Continued)



Training vs. EVA (Recurring Injury)



Predictive Statistics Results– Highlights

Predictive Stats Overview

- All analyses performed using SAS 9.3
- Given quality of input data, considered exploratory analysis with significance at $p<0.15$ (as opposed to 0.05)
- Principal components analysis [PCA] was employed to reduce 26 anthropometric hand measures
- Logistic regression to evaluate risk of overall injury and risk of onycholysis injury against candidate independent variables
- Survival analysis to evaluate time to first injury and time to onycholysis injury against candidate independent variables

Training – All Injuries

Risk	Event Type	Odds Ratio (95% Confidence Interval)	Hazard Ratio (95% Confidence Interval)	p-Value	Thoughts
Being left-handed increases risk of injury by 2.3 times	Training	2.290 (0.963-5.444)		0.061	This matches industry research which demonstrates nearly two times increase risk of injury due to task , tool, and machine bias
Phase VI glove has 4x risk of injury over 4000 series	Training	4.001 (1.336-11.980)		0.013	4000 Series seems to have a protective factor over Phase VI
For every additional hour of training event duration translated to 70% increase in injury risk and a 2.4x faster reporting rate	Training	1.697 (1.741-2.453)	2.368 (1.241-4.517)	0.005; 0.009	
Rate of injury reporting decreased by 24% for every additional year in age; meaning younger crewmembers reported earlier in career	Training		0.760 (0.686-0.842)	<0.001	
Larger handed crew reported injuries 21% faster	Training		1.208 (1.098-1.330)	0.001	
For every additional training or EVA event logged, 2.6% decrease in injury	Training		0.974 (0.963-0.985)	<0.001	
Every additional 1/10" of delta between glove size and middle finger length equaled an 18% increase in injury reporting	Training		5.222 (0.737-36.999)	0.098	

EVA – All Injuries

Risk	Event Type	Odds Ratio (95% Confidence Interval)	Hazard Ratio (95% Confidence Interval)	p-Value	Thoughts
Being left-handed increases risk of injury by 2.3 times.	Training	2.290 (0.963-5.444)		0.061	This matches industry research which demonstrates nearly two times increase risk of injury due to task , tool, and machine bias
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Onycholysis – EVA + Training

Risk	Event Type	Odds Ratio (95% Confidence Interval)	Hazard Ratio (95% Confidence Interval)	p-Value	Thoughts
Women have a 2.62x greater odds of onycholysis than men	Training & EVA	2.622 (0.997-6.894)		0.051	Contradicts previous study by Opperman et al 2010; Anectdotal evidence in dermatology literature indicates more women due to cosmetics, overagressive care, and household task exposures
For every year of increase in age there was a 6.5% increase in onycholysis risk yet 24% reduction in reporting rate	Training & EVA	1.065 (0.981-1.156)	0.764 (0.648-0.900)	0.131; <0.001	Younger crewmembers reported onycholysis faster in their careers
Phase VI has 8.5x risk of onycholysis over 4000 Series	Training & EVA	8.535 (0.961-75.811)		0.054	4000 Series seems to have a protective factor over Phase VI
For every additional training or EVA hour of event duration, there was a 57% increased risk of onycholysis and 2.37x faster reporting rate	Training & EVA	1.570 (0.857-2.875)	2.370 (1.319-4.260)	0.144; 0.004	
Every additional 1/10" of delta between glove size and middle finger length equalled an 23% increase in onycholysis risk and a 60% faster reporting rate	Training & EVA	7.709 (0.746-79.623)	108.871 (3.928-3017.190)	0.087; 0.006	Onycholysis risk further increases when accounting for Phase VI gloves only
Larger handed crewmembers reported onycholysis at a faster rate than smaller handed crewmembers	Training & EVA		1.230 (1.058-1.431)	0.007	
For every additional training or EVA event, there was a 3% decrease in onycholysis reporting rate	Training & EVA		0.971 (0.955-0.988)	<0.001	

Onycholysis – EVA + Training (Phase VI Glove only)

- Based on previous analyses by Opperman et al finding association between fingernail onycholysis and increased hand circumference, an attempt was made to replicate this analysis to the extent possible to corroborate the results
  - Right-handed males only
  - Slightly differing data sets (12 injured/120 vs. Opperman 16 injured/157); rates identical within 0.2 percentage points
  - Individual logistic regressions for 13 anthropometric measures including hand circumference
  - Did not include BMI in analysis as was done in Opperman et al
- Again, results showed no correlation between hand circumference and onycholysis (OR = 2.325 (0.662-8.165); p=0.188)
- Results show correlation between onycholysis and larger index finger circumference (OR = 48.1 (1.5-999); p=0.028) and middle finger circumference (OR = 69.8 (1.14-999); p=0.043)
  - Interestingly enough, these are the two fingernails most commonly reported with injuries
  - Bottom line, we were not able to corroborate previous analysis indicating that larger hand circumferences are a risk to onycholysis

Discussion

Discussion – Overall Injuries

- Taken cumulatively, the descriptive / predictive stats suggest the following:
  - Taken in conjunction with age results, total number of events results, and non-significance of the same in logistic regression suggests that older, more experienced crew develop their own protection against injury through sizing tweaks and experience working in the suit (or slow reporting)
  - Most glove injury onsets may be acute; not chronic in nature
    - Caveat that inconsistent data over time does not lend itself well to investigating cumulative/chronic injury
  - Ergonomic task analysis including an evaluation of handedness bias in EVA training classes should be considered
  - Training events should be limited in time to the extent possible
  - Optimizing suit/glove fit early in a crewmember's career may contribute to reduction of injury
  - Facilitating adequate suit/glove sizing by employing large finger take-ups could be contributing to injury and therefore may not be recommended

Discussion – Overall Injuries (Continued)

- Taken cumulatively, the descriptive / predictive stats suggest the following:
  - The 4000 Series and/or its implementation into the EMU assembly may provide a protective factor for injury versus the Phase VI glove
  - Previous analysis conducted by Opperman et al (2010) found increased risk of onycholysis with greater hand circumference (n=20; right-handed males in Phase VI; p=0.003). This study was not able to reproduce these findings (n=31; p=0.61) and in many cases found opposite results (e.g., OR of 0.612; p=0.07 for general EVA injuries)
  - The lack of consistency between independent exposure variables related to EVA flight and training injury risk most likely indicates that these exposure events have different risk profiles or different injury reporting standards between them

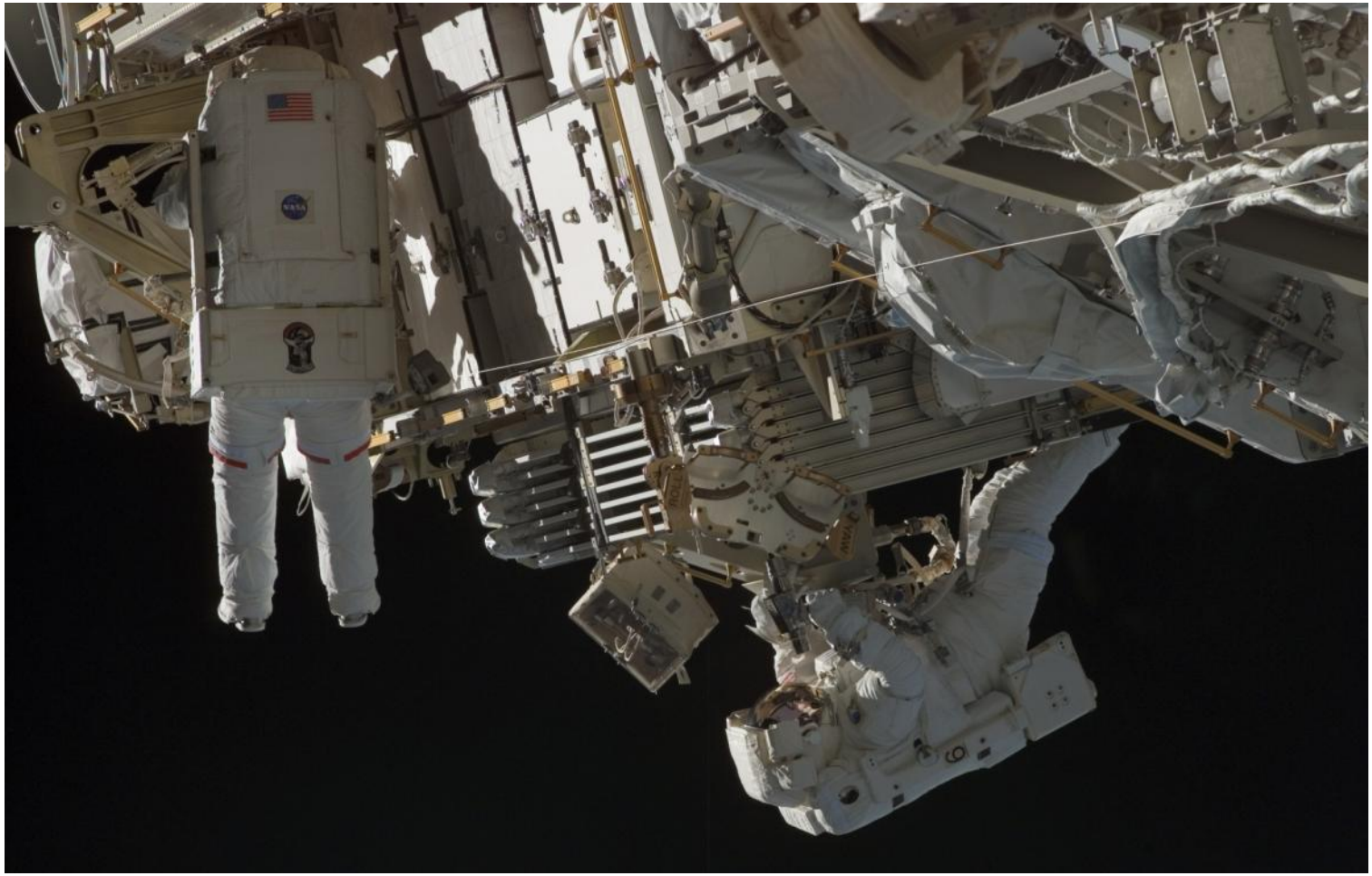
Discussion: Injury Reporting Issues

- Inconsistent reporting methods through time
- Inconsistent reporting methods across training/EVA
- Inconsistent reporting rigor
- Lack of reporting in general
- Lack of standard injury nomenclature
- Lack of severity scale
- Lack of context to injury (task, etc.)
- Lack of detailed time-keeping of training runs (many estimated at 6hrs)
- Collection of injury metrics was originally intended for a clinical role, not to support retrospective analyses
  - However, there is still missed opportunity in quality data with which engineering and operational countermeasures to injury could be developed

Future Work

- FY15 plan to develop new suit injury tracking system
  - Comprehensive data gathering to provide context
  - Standardize and simplify data collection methods across all JSC stakeholder directorates
  - Provide back-end (data storage/analysis) and front-end (web-based/mobile app) software
  - Rigorous protection of PII and medical data
  - Intent of this venture is for future prospective and retrospective injury studies
- Incorporate this data studies results into journal publication
  - Scandinavian journal of work, environment & health

Any Questions?



Backup Slides

Principal Components Analysis

26 Hand Measures

Hand Breadth Left
Hand Breadth Right
Hand Circumference Left
Hand Circumference Right
Hand Length Left
Hand Length Right
Index Circumference Left
Index Circumference Right
Index Length Left
Index Length Right
Little Circumference Left
Little Circumference Right
Little Length Left
Little Length Right
Middle Circumference Left
Middle Circumference Right
Middle Length Left
Middle Length Right
Ring Circumference Left
Ring Circumference Right
Ring Length Left
Ring Length Right
Thumb Circumference Left
Thumb Circumference Right
Thumb Length Left
Thumb Length Right

	Eigenvalue	Proportion of Variance Explained	Cumulative Variance Explained
Anthropometric Principal Component-1	16.304	0.627	0.627
Anthropometric Principal Component-2	3.649	0.140	0.767
Anthropometric Principal Component-3	0.956	0.037	0.804

Only Anthropometric PC-1 was retained in the statistical model (62.7% PVE) as individual eigenvectors of PC-2 and PC-3 were both positive and negative

Training – All Injuries

Logistic Regression

	Estimate	Standard Error	p-value	Odds Ratio (95% Confidence Interval)
Intercept	-10.368	1.591	<0.001	
Sex	0.917	0.644	0.154	2.502 (0.709-8.832)
Age	0.018	0.036	0.619	1.018 (0.949-1.091)
Handedness	0.844	0.387	0.029*	2.325 (1.088-4.966)
Anthropometric Principal Component-1	0.036	0.067	0.588	1.037 (0.910-1.182)
Glove Model	1.078	0.635	0.089*	2.938 (0.847-10.192)
Duration of Training Event (hours)	0.507	0.188	0.007*	1.660 (1.149-2.399)
Number of Training/EVA Events in Past Month	-0.003	0.060	0.962	0.997 (0.887-1.122)
Delta: Glove Size and Anthropometry for Middle Finger Length	0.227	0.743	0.761	1.254 (0.292-5.383)
Delta: Glove Size and Anthropometry for Hand Circumference	0.129	0.303	0.670	1.138 (0.629-2.060)
Training 2002 - 2004	2.173	0.299	<0.001*	8.781 (4.888-15.775)

	Estimate	Standard Error	p-value	Odds Ratio (95% Confidence Interval)
Intercept	-9.823	1.063	<0.001	
Handedness	0.829	0.442	0.061*	2.290 (0.963-5.444)
Glove Model	1.387	0.560	0.013*	4.001 (1.336-11.980)
Duration of Training Event (hours)	0.529	0.188	0.005*	1.697 (1.741-2.453)
Training 2002-2004	2.186	0.301	<0.001*	8.903 (4.935-16.063)

Being left-handed increases risk of injury by 2.3 times. This matches industry research which demonstrates nearly two times increase risk of injury due to task , tool and machine bias

Phase VI has 4x risk of injury over 4000 series. Reporting differences controlled to extent possible for 2002-4. Regardless, 4000 Series or implementation thereof (longer vent tube length) seems to have protective factor over the Phase VI

Every additional hour of training event translated to 70% increased injury risk

Training – All Injuries

Survival Analysis

	Parameter Estimate	Standard Error	p-value	Hazard Ratio (95% Confidence Interval)
Training 2002-2004	1.421	0.376	0.001*	4.139 (1.979 – 8.657)
Sex	-0.747	0.726	0.304	0.474 (0.114 – 1.967)
Age	-0.280	0.058	<0.001*	0.756 (0.674 – 0.847)
Handedness	-0.092	0.519	0.860	0.913 (0.330 – 2.523)
Anthropometric Principal Component-1	0.133	0.071	0.060*	1.142 (0.994 – 1.311)
Glove Model	-0.929	0.840	0.269	0.395 (0.076 – 2.049)
Duration of Training event (hours)	1.067	0.377	0.005*	2.907 (1.390 – 6.081)
Total Number of Prior Events (EVA or Training)	-0.030	0.006	<0.001*	0.971 (0.958 – 0.983)
Number of Training/EVA events past month	0.048	0.128	0.705	1.050 (0.817 – 1.349)
Delta: Glove Size and Anthropometry for Middle Finger Length	1.321	1.050	0.208	3.748 (0.479 – 29.333)
Delta: Glove Size and Anthropometry for Hand Circumference	-0.263	0.428	0.539	0.769 (0.333 – 1.779)

	Parameter Estimate	Standard Error	p-value	Hazard Ratio (95% Confidence Interval)
Age	-0.274	0.052	<0.001*	0.760 (0.686 - 0.842)
Anthropometric Principal Component-1	0.189	0.049	0.001*	1.208 (1.098 - 1.330)
Duration of Training event (hours)	0.862	0.330	0.009*	2.368 (1.241 - 4.517)
Total Number of Prior Events (EVA or Training)	-0.026	0.006	<0.001*	0.974 (0.963 - 0.985)
Delta: Glove Size and Anthropometry for Middle Finger Length	1.653	0.999	0.098*	5.222 (0.737 - 36.999)
Training 2002-2004	1.415	0.369	0.001*	4.117 (1.996 - 8.491)

For every additional year in age, rate of reporting an injury decreased by 24%; meaning that younger crewmembers report first injury earlier in their career

Larger-handed crew report injuries at a 21% faster rate

Every additional hour of training event translated to 2.4x faster reporting rate

For each additional event logged, 2.6% decreased rate of injury.

Additional 1/10” delta between glove size and middle finger length translated to 18% increased injury reporting rate

Taken in conjunction with age results, total number of events results, and non-significance of the same in logistic regression suggests that older, more experienced crew develop their own protection against injury through sizing tweaks and experience working in the suit (or slow reporting)

EVA – All Injuries

Logistic Regression

	Estimate	Standard Error	p-value	Odds Ratio (95% Confidence Interval)
Intercept	-1.847	3.668	0.615	
Sex	-0.667	1.131	0.556	0.514 (0.056-4.7131)
Age	0.053	0.072	0.458	1.055 (0.917-1.214)
Handedness	0.526	0.739	0.476	1.693 (0.398-7.198)
Anthropometric Principal Component-1	-0.211	0.128	0.099*	0.810 (0.630-1.041)
Glove Model	-0.037	0.675	0.957	0.964 (0.257-3.616)
Duration of EVA (hours)	-0.066	0.252	0.793	0.936 (0.571-1.534)
Number of Training/EVA events past month	-0.012	0.102	0.910	0.986 (0.810-1.207)
Delta: Glove Size and Anthropometry for Middle Finger Length	-0.915	1.497	0.541	0.401 (0.021-7.531)
Delta: Glove Size and Anthropometry for Hand Circumference	-0.208	0.456	0.648	0.812 (0.332-1.985)
Training 2002 to 2004	0.429	0.516	0.405	1.536 (0.559-4.220)

	Estimate	Standard Error	p-value	Odds Ratio (95% Confidence Interval)
Intercept	-0.694	0.174	<0.001	
Anthropometric Principal Component-1	-0.081	0.053	0.126*	0.922 (0.831-1.023)

Only Anthropometric PC-1 was found to be significant with EVA Injuries

As size of hand increases, risk of injury decreases; significant at p=0.126

Contradicts Opperman et al 2010 indicating increased hand circumference having increased risk of onycholysis injury specifically

Post-hoc analysis analyzing hand circumference specifically found OR of 0.612 (p=0.07) further contradicting Opperman's study

EVA – All Injuries

Survival Analysis

	Parameter Estimate	Standard Error	p-value	Hazard Ratio (95% Confidence Interval)
Sex	-1.991	1.262	0.115	0.137 (0.012-1.619)
Age	-0.015	0.082	0.857	0.985 (0.840-1.156)
Handedness	0.135	0.727	0.853	1.144 (0.275-4.756)
Anthropometric Principal Component -1	0.113	0.117	0.334	1.119 (0.890-1.408)
Glove Model	-3.227	1.310	0.014*	0.040 (0.003-0.517)
Duration of EVA event (hours)	0.510	0.312	0.102*	1.666 (0.903-3.073)
Total Number of Prior Events (EVA or Training)	-0.062	0.015	<0.001*	0.939 (0.913-0.967)
Number of Training/EVA events past month	-0.190	0.228	0.406	0.827 (0.529-1.294)
Delta: Glove Size and Anthropometry for Middle Finger Length	4.569	2.008	0.023*	96.404 (1.884-4933.76)
Delta: Glove Size and Anthropometry for Hand Circumference	0.585	0.677	0.388	1.795 (0.476-6.767)

	Parameter Estimate	Standard Error	p-value	Hazard Ratio (95% Confidence Interval)
Sex	-2.369	0.860	0.006*	0.094 (0.017-0.505)
Glove Model	-2.153	0.929	0.020*	0.116 (0.019-0.717)
Duration of EVA event (hours)	0.477	0.295	0.106*	1.611 (0.903-2.872)
Total Number of Prior Events (EVA or Training)	-0.062	0.014	<0.001*	0.940 (0.915-0.965)
Delta: Glove Size and Anthropometry for Middle Finger Length	3.328	1.613	0.039*	27.890 (1.181-658.741)

Men report injuries at a faster rate than women, likely due to men representing a much higher proportion (79%) of crew population

Crew using 4000 Series gloves reported injuries much faster than in the Phase VI. This likely results from a correlation with reduced time from training to EVA in the 4000 Series vs the Phase VI (5.64 and 8.25 years, respectively)

For every hour increase in EVA length, injury was reported at 61% faster rate

Additional 1/10” delta between glove size and middle finger length translated to 40% increased risk. Although a small sample size for EVA translates to a very wide confidence interval, it does back up similar findings elsewhere in the analysis

Onycholysis – EVA + Training

Logistic Regression

Parameter	Parameter Estimate	Standard Error	p-value	Odds Ratio (95% Confidence Interval)
Intercept	-13.247	2.186	<0.001	
Sex	0.841	1.047	0.422	2.318 (0.298-18.045)
Age	0.063	0.046	0.174	1.065 (0.973-1.166)
Handedness	0.510	0.691	0.460	1.666 (0.430-6.448)
Anthropometric Principal Component-1	-0.002	0.116	0.986	0.998 (0.796-1.252)
Glove Model	1.921	1.226	0.117*	6.827 (0.618-75.444)
Duration of Training/EVA event (hours)	0.449	0.309	0.146*	1.567 (0.855-2.871)
Number of Training/EVA events past month	-0.112	0.117	0.336	0.894 (0.712-1.123)
Delta: Glove Size and Anthropometry for Middle Finger Length	2.065	1.018	0.043*	7.789 (1.073-58.001)
Delta: Glove Size and Anthropometry for Hand Circumference	0.352	0.598	0.556	1.422 (0.440-4.596)
Training or EVA?	0.966	0.620	0.119	2.627 (0.780-8.852)
Training 2002-2004	1.273	0.392	0.001*	3.573 (1.658-7.699)

Parameter	Parameter Estimate	Standard Error	p-value	Odds Ratio (95% Confidence Interval)
Intercept	-13.194	2.365	<0.001	
Sex	0.964	0.493	0.051*	2.622 (0.997-6.894)
Age	0.063	0.042	0.131*	1.065 (0.981-1.156)
Glove Model	2.144	1.114	0.054*	8.535 (0.961-75.811)
Duration of Training/EVA event (hours)	0.451	0.309	0.144*	1.570 (0.857-2.875)
Delta: Glove Size and Anthropometry for Middle Finger Length	2.042	1.191	0.087*	7.709 (0.746-79.623)
Training or EVA?	0.928	0.611	0.129*	2.529 (0.763-8.381)
Training 2002-2004	1.272	0.398	0.001*	3.566 (1.633-7.786)

Women have 2.62x greater odds of onycholysis, contradicting previous studies by Opperman. Anecdotal evidence in dermatology literature indicates onycholysis is more prevalent in women than men due to cosmetics, overaggressive care and different household task exposures

6.5% increased risk of onycholysis with every year increase in age.

Phase VI has 8.5x risk of onycholysis over 4000 series. Despite controlling for 2002-4 reporting differences, 4000 Series or implementation thereof (longer vent tube length) seems to have protective factor over the Phase VI

Every additional hour of training event translated to 57% increased onycholysis risk

Additional 1/10” delta between glove size and middle finger length translated to 23% increased risk

PC-1 was not significant at p=0.986 contradicting previous studies by Opperman. Post-hoc analysis analyzing hand circumference specifically found OR of 1.386 (p=0.611) further showing non-significance

Onycholysis – EVA + Training

Survival Analysis

Parameter	Parameter Estimate	Standard Error	p-value	Hazard Ratio (95% Confidence Interval)
Sex	-0.147	1.275	0.908	0.863 (0.071-10.513)
Age	-0.251	0.096	0.009	0.778 (0.645-0.939)
Handedness	-0.896	0.985	0.363	0.408 (0.059-2.812)
Anthropometric Principal Component-1	0.186	0.122	0.126	1.205 (0.949-1.530)
Duration of Training/EVA event (hours)	0.887	0.334	0.008	2.427 (1.260-4.675)
Total Number of Prior Events (EVA or Training)	-0.034	0.011	0.002	0.966 (0.946-0.988)
Number of Training/EVA events past month	0.082	0.212	0.700	1.085 (0.717-1.643)
Delta: Glove Size and Anthropometry for Middle Finger Length	3.946	1.814	0.030	51.731 (1.477-1812.352)
Delta: Glove Size and Anthropometry for Hand Circumference	-0.117	0.743	0.875	0.890 (0.208-3.816)
Training 2002-2004	1.447	0.606	0.017	4.252 (1.297-13.935)

Parameter	Parameter Estimate	Standard Error	p-value	Hazard Ratio (95% Confidence Interval)
Age	-0.269	0.084	<0.001	0.764 (0.648-0.900)
Anthropometric Principal Component-1	0.207	0.077	0.007	1.230 (1.058-1.431)
Time of Training/EVA Event (hours)	0.863	0.299	0.004	2.370 (1.319-4.260)
Total Number of Prior Events (EVA or Training)	-0.029	0.008	<0.001	0.971 (0.955-0.988)
Delta: Glove Size and Anthropometry for Middle Finger Length	4.690	1.695	0.006	108.871 (3.928-3017.190)
Training 2002-2004	1.453	0.581	0.012	4.275 (1.369-13.348)

Every year increase in age, corresponding 24% reduction in onycholysis rate (younger crewmembers report onycholysis faster in their careers)

Larger-handed crewmembers reported onycholysis at a faster rate than smaller-handed crewmembers

For every additional event logged, 3% decrease in onycholysis reporting rate

Every additional hour increase in the duration of the event corresponded to a 2.37x faster rate of onycholysis

Additional 1/10” delta between glove size and middle finger length translated to 60% faster rate of onycholysis reporting

Taken in conjunction with age results and total number of events results, suggests that older, more experienced crew develop their own protection against onycholysis through sizing tweaks and experience working in the suit