

**GTR 7 Informal Working Group**  
**February 12, 2013**  
**Brussels**

# **Discussion (draft) on Injury Risk Curve**

**JASIC/JARI**

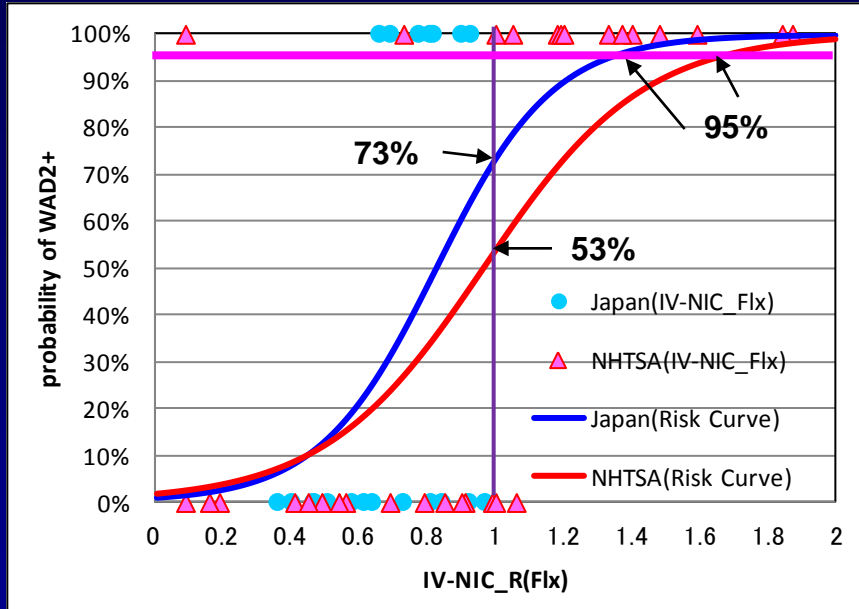
# Background

- Injury Risk Curve (IRC) and Injury Criteria (IC: WAD2+ risk 5%, 95% value) based on FE simulation in comparison with the IV-NIC by the PMHS tests done by NHTSA were recommended.
- At the last GTR7 meeting, the Chairman recommended that 50% of Injury Risk Threshold (IRT) should be accomplished.
- It should be necessary to discuss the IRC based on recommendations from Japan.
- However, there will be new additional PMHS data coming from NHTSA (VRTC).
- The data and results from NHTSA will be needed for the arguments on the IRT.
- As for Japan, the IRT should be accomplished with the integrated analysis and new additional PMHS data from NHTSA (VRTC) based on the recommended IRC and IC from Japan.
- Here, for the sake of convenience, the current progress in Japan is introduced in the informal GTR7 meeting.

# Injury Risk Curves based on the FE Simulations

Risk Curve of IV-NIC (Flx) by the FE Simulations (presented to the last GTR7 meeting on December, 2012) Reference Values

## Flexion

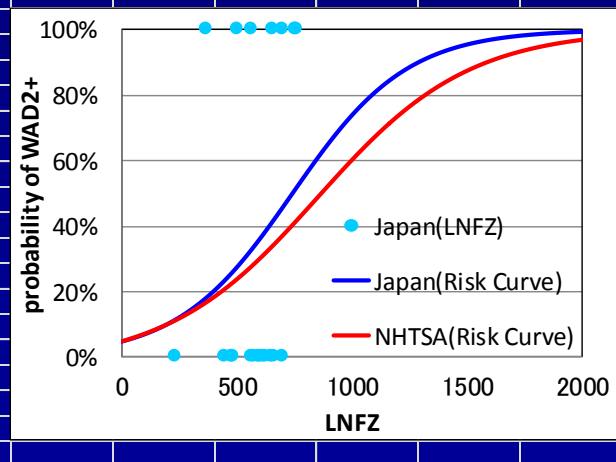
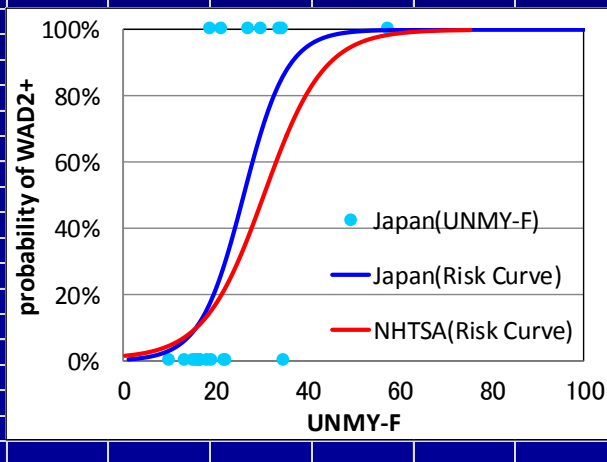
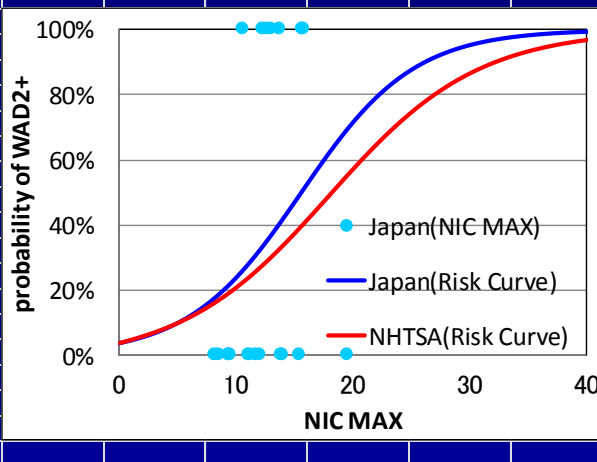
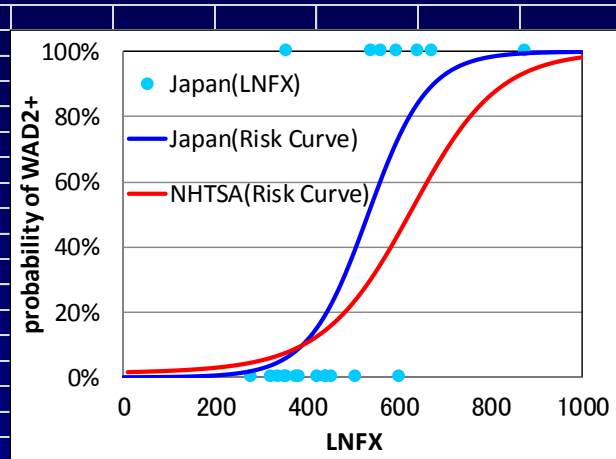
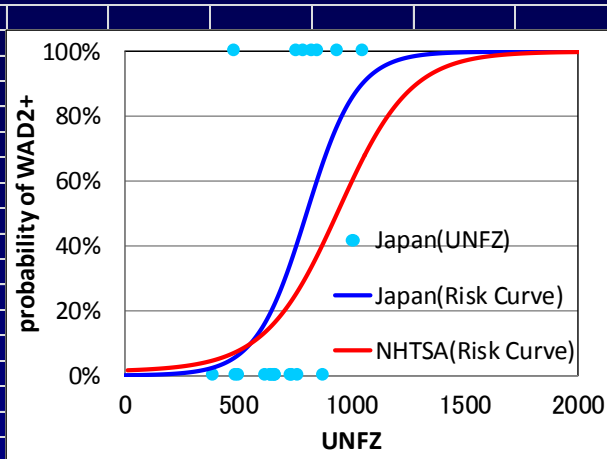
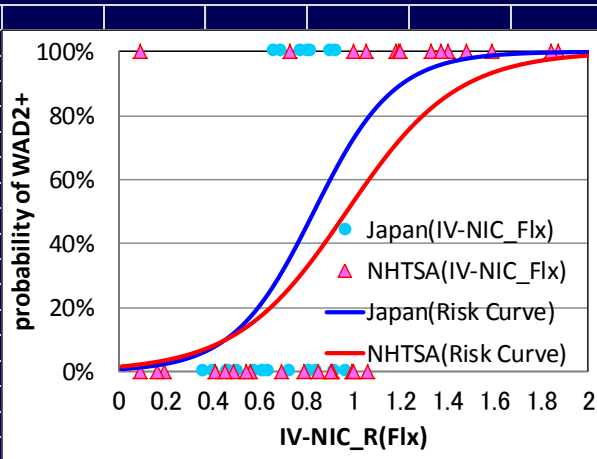


WAD2+  
95% Value

Injury Criteria		WAD2+	
		95% Value	
		Japan	NHTSA
IV-NIC Rotation Flexion		1.34	1.66
NIC Max		30	
Upper Neck	FX	730	Calculation from the value of left table.
	FZ	1130	
	MY(Flx)	40	
	MY(Ext)	40	
Lower Neck	FX	730	
	FZ	1480	
	MY(Flx)	40	
	MY(Ext)	40	

- ◆ The method of calculating neck force/moment was calculated from the ratio in the WAD2+ 95%ile value of IV-NIC(R·Flx). For example, in NHTSA, it is a ratio of values in the red frame to the value in the blue frame in the table on the right.
- ◆ In the case of IV-NIC = 1 based on the NHTSA (Risk Curve), the probability of WAD2+ is 53.3%.
- ◆ In the case of IV-NIC = 1 based on the JARI (Risk Curve), the probability of WAD2+ is 72.9%.

# Injury Risk Curve (IRC) of PMHS (NHTSA) deduced by multiplying results of the IRC of the FE Simulation (Japan) with the ratio of values (1.24) shown in the previous page.



Questions?

4) WAD and AIS

In most commonly, the symptom of the occupants in the automobile accidents is evaluated at the WAD. On the other hand, neck injury of the PMHS tests in NHTSA, is evaluated at the AIS. Therefore, the relationship between WAD and AIS were as follows.

WAD classification  
(Risk curve of Japan)

AIS classification  
(Risk curve of NHTSA)

WAD	
Grade	Clinical classification
0	The neck has no symptoms, and the physical finding is normal.
1	The neck has pain and stiffness, but the physical finding is normal.
2	In addition to neck symptoms, there is a limit of motion space of the cervical vertebra and a localized tender point, suggesting neck symptoms from the musculoskeletal system.
3	In addition to neck symptoms, there are neurological findings such as the tendon reflex disorder, Adynamia, and perception disorder.
4	Dislocation and fracture of the cervical vertebra.

AIS	
Grade	Clinical classification
0	No Injury
1	<ul style="list-style-type: none"> <li>• Strain, acute with no fracture or dislocation</li> <li>• Inter-spinous ligament laceration</li> </ul>
2	<ul style="list-style-type: none"> <li>• Dislocation (subluxation) without fracture facet unilateral</li> <li>• Disc injury</li> </ul>
3	<ul style="list-style-type: none"> <li>• Dislocation (subluxation) without fracture facet bilateral</li> </ul>



6) WAD and AIS (continued-2)

The AIS classifications of the cervical spine injuries in the PMHS tests (NHTSA) are as follows.

Injury Documentation						
	PMHS03	PMHS04	PMHS05	PMHS06	PMHS07	PMHS08
C2/C3	No injury	No injury	AIS3	No injury	No injury	No injury
C3/C4	AIS3	No injury	AIS2	No injury	No injury	No injury
C4/C5	AIS3	AIS3	AIS3	No injury	AIS2	No injury
C5/C6	No injury	AIS3	AIS2	AIS2	No injury	No injury
C6/C7	No injury	AIS1	AIS1	No injury	AIS3	AIS1

Note) In the PMHS tests, the evaluation of the inflammation of the soft tissues and the neurologic signs etc. are impossible. Those output might indicate no-injury.