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## Using Dice Games to Teach Hazards, Risk, and Outcomes in HACCP Classes

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### Abstract

This article describes the incorporation of a dice game (piggy) to teach food safety hazards and risk in an engaging way in HACCP classes. Each player accumulates points by rolling two dice, but loses points in a turn when rolling a 7, or all accumulated points when rolling two consecutive doubles. This game helps explain the difference between a concrete event, a hazard (number 7) and risk of that hazard occurring (the probability of rolling number 7). Two consecutive doubles inflict a more severe loss and can help explain the variability in outcomes of food safety hazards.

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### Introduction

The implementation of HACCP (hazard analysis and critical control points) plans, the concepts of hazard analysis and critical control points, and the application of the risk analysis framework in the 1990s gave rise to policies that are risk based and integrate the current known variables that contribute to the appearance of hazards in foods (Murphy, 2013). In the U.S., the teaching of HACCP has been driven primarily by the curriculum put together by the International HACCP Alliance in the 1990s from documents by the National Advisory Committee on Microbiological Criteria for Foods (NACMCF 1998). In these classes, participants are taught that HACCP plans address primarily "significant hazards," those determined to be so based on the likelihood of occurrence (probability) and severity (magnitude of loss). Yet, in more than 15 years of teaching HACCP, the terms that are still confusing in the minds of participants are "hazards" and "risk," and in many cases participants think that these two terms are synonyms. Understanding the distinction between these key terms is very important to food safety personnel and food safety professionals in charge of food safety programs.

### Approach

To introduce an active learning experience (Lo, Fukushima, Rippert, Gdovin, & Hahm, 2004), the use of pig 7 or piggy, a dice game, has helped me explain the concepts of hazards and risk in an engaging

way. There are different variations of piggy, which has been adapted from "pig," which is played with only one dice, but the main idea is that players accumulate points and the one that reaches 100 wins. I explain to participant that players accumulate points by rolling two dice, but they lose all points in a turn when rolling a 7. Players lose all accumulated points when rolling two consecutive doubles. If they roll one double, they are obliged to roll the dice again. Other than that, players decided when to stop rolling at each turn.

In the last 2 years I have incorporated three multiple choice questions before starting the games. These questions are:

Question A: Definition of Hazard

1. The likelihood of occurrence of an event
2. A concrete risk
3. An event that is harmful
4. An event that can have a negative or a positive outcome
5. The negative results of an event

Question B and C are Definition of Risk and Definition of Outcome, respectively. However, answers for Questions B and C are the same as those in A. After tallying the answers and playing for 10-15 minutes, the answers are discussed with the participants and within the context of the game. The number 7 in the game is a concrete event with a negative connotation, a hazard. Rolling two consecutive doubles also compares to a hazard, but one with a more severe loss. The probability of number 7 appearing after rolling the dice is compared to the term "risk." After discussing these terms, the same three questions presented at the beginning are presented again to all participants, and the new tallies of the answers are compared to the previous ones.

The hazard from the game can be compared to a particular biological hazard recognized in a food product. The main learning objective from the use of this dice game is: 1) Understand the differences between hazard and risk. However, two other learning objectives can be achieved: 2) Review the importance of uncertainty when assessing microbial hazards, and 3) Understanding the limitations of risk-based approaches to mitigate the appearance of foodborne hazards. The term "uncertainty" can be introduced by asking participants to describe the best way to win the game (accumulate the most points). At this point in the discussion, most participants realize that any statistical tool based on math and calculations will provide a close approach to predict the appearance of the number 7, which is the number from 2 to 12 with the highest probability of appearance when rolling two dice. But participants are also aware of the limitations of this approach and understand that uncertainty is a major force behind the appearance of hazards.

This discussion is always appreciated by participants who believe we have all the necessary tools to prevent the appearance of foodborne hazards all the time. The opposite is also true when participants realize that the science of food safety is advanced enough to help us recognize high-risk foods and

high-risk practices. To show how complex the mathematical calculations are in predicting numbers from playing with two dice, participants can be shown the publications by Neller & Presser (2004) and Neller (2010).

Describing and discussing hazards and risk helps participants understand the use of the term "risk based" in documents generated by regulatory agencies in the U.S. Our major approaches to understand and control the appearance of foodborne hazards, particularly microbial hazards, are "risk based."

There are cases when participants originally choose answer #4 to describe "outcome." For these participants the results of taking a risk can be positive or negative. However, food safety hazards always have a negative outcome, with a varying degree of severity, as it is the case of the loss from rolling a 7 or two consecutive doubles. The idea behind the consecutive doubles is to promote the appearance of an event that has low probability of concurrence but has very negative results (all accumulated points are lost). The term "threat" is used in bioterrorism to describe an event with very low probability of occurrence but with catastrophic results. I discourage the use the term "threat" in food safety and prefer leaving this term for bioterrorism discussions.

## Conclusions

The incorporation of a simple dice game can provide for an engaging way to explain the concepts of hazard and risk, especially when teaching HACCP classes to adults. These games are relatively inexpensive, and two dice could be enough for a group of six participants to play. A clear understanding of these terms help participants comprehend other, more complex terms within HACCP, such as "hazard analysis," and further differentiate this term from "risk assessment," which is a component of the risk analysis framework.

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