

Guidance Sheet

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Introduction

The antibiotic development board game was developed by Dr Jody Winter to promote understanding of the steps and hurdles involved in the antibiotic development pipeline – from the initial discovery of an active compound in the laboratory to final product entering the market. This student-generated board game is highly engaging and interesting, benefitting from simple set up requirements – a cardboard paper and stick notes.

This antibiotic development board game tool kit contains the following resources to support the delivery of the game:

1. Guidance sheet – which provides guidance on how to conduct the antibiotic development boardgame.
2. Workshop slides – PowerPoint presentation on background of drug development and setting up the game
3. Cheat sheet – Steps and hurdles- contains a list of potential hurdles identified for each stage, useful when helping the students to identify the hurdles.
4. Conference Poster Presentation- Poster presented on the board game
5. Adapted antibiotic development board game – An adapted version of the game for a larger cohort of medical students
6. Printable board

This document provides guidance on how to conduct the antibiotic development boardgame.

The accompanying workshop slides provide some session context for the students on the need for new antibiotics and the challenges involved in bringing a new drug to market.

Before setting up the game, it is useful to have a brain-storming session with the cohort, asking them to think about the steps involved in bringing a new drug to market - this is particularly helpful for when they have to "build" the game by identifying potential hurdles in the process.

The rules of the game are described in the final three slides of the workshop PowerPoint slides and in general, we build and play the game as follows:

Building the game: Split students into 4 groups - each group gets assigned a different phase of the drug development pipeline (pre-clinical, clinical, regulatory approval and success on market / monitoring). For their stage, each group should identify **up to 5** hurdles (reasons why a drug might fail at this stage) and one route to success (for example, drug passes clinical trials with minimal side effects) and give each hurdle a number from 1-6. They should then write their hurdles and success route on sticky notes which can be attached to the board. This way the four groups will "build" the game. There are 2 ways to do this, you can have each group write out the hurdles in quadruplicate and share them with the other groups - then each group gets their own version of the game when they share all the sticky notes. You then start them off at the same time and see which group completes the game first. Or you bring them all together, assemble one game board and they play together. Figure 1 shows a student-generated boardgame.

Playing the game: Students start at the drug discovery phase – We would usually fill this out for the students, so it gives them some examples when talking about how to build the game. The students have a budget of 2,000 million pounds to complete the game and each time they roll the dice it will cost them £100 million. That means they have **20 rolls** to complete the game. If they roll a number which corresponds to a hurdle/failure at a particular stage, they stay where they are and don't advance, they should keep track of how many total rolls they have had. They should keep rolling until they get a number which corresponds to the successful outcome they identified at that particular stage - they can then advance to the next stage of the drug development pipeline. If they reach 20 rolls and have not completed the game - they have gone bankrupt and must start again from the beginning.

It will often take them 3 or 4 turns to complete the game, this should emphasize to them that there are many failures before developing a successful drug and that each failure also costs you a significant amount of money - this is why drug companies charge so much for successful drugs as they must also cover their losses.

A "cheat sheet" is also included in this resource pack and contains a list of potential hurdles identified for each stage - it can be useful when helping the students to identify the hurdles.

We would usually print out the board (see file: "Printable Board") in A3 size.

Time (years)	Money (£)	INDEFINITE £2000 MILLION ↑	SUCCESS ON MARKET / MONITORING (PHASE IV)						
			1 Resistance develops: X	2 Poor demand = bankruptcy: X	3 Production costs too high: X	4 Better antibiotic produced by rival : X	5 Longer term side effects observed: X	6 Antibiotic is effective and no resistance: ✓	
1-2			1-2 Interacts adversely with other drugs : X		3 Production facilities fail inspection: X	4 Clinical trials not performed to standard: X		5 or 6 MHRA approve drug: ✓	REGULATORY APPROVAL
6-7			1 Toxic in certain subpopulation: X	2 Poor efficacy in larger trials: X	3 Less effective than current treatment: X	4 Resistance observed : X	5 or 6 Effective at curing infection, no side effects: ✓		CLINICAL TRIAL PHASES <div>III</div> <div>II</div> <div>I</div>
			1 Drug not effective in humans at all: X	2 Drug no better than placebo: X	3 Severe side effects observed: X	4 Only effective in small sub-population: X	5 or 6 Effective at curing infection, no side effects: ✓		
			1-2 Poor PK/PD profile in humans: X	3-4 Severe side effects in humans: X		5 Unexpected off-target effects: X	6 Safe in humans, no side effects:✓		
3-6			1 IC50 value too high in vitro: X	2 Poor ADME profile in animals: X	3 Severe side effects in animals: X	4 Not effective in animal model of infection: X	5 or 6 Effective in animal model, no side effects:✓		PRE-CLINICAL TRIALS
			1 or 2 No new antibiotic producers found: X	3 Producer found but antibiotic is made in small quantities / is unstable: X	4 Producer found but the antibiotic only kills lactobacillus: X		5 or 6 New antibiotic discovered with activity against 1 or more ESKAPE pathogens:✓		DRUG DISCOVERY + DEVELOPMENT

Figure 1: A student generated boardgame showing the four major phases of drug development - pre-clinical, clinical, regulatory approval and success on market/monitoring and various hurdles to be overcome in each phase.

Phase 1 could be pre-populated as a guide while students are encouraged to identify potential hurdles for other phases and ‘build’ the game.

Alternative session plan (for larger groups and/or shorter session times)

Having the students brainstorm and assemble the game themselves is good for active learning but will work best in a relatively small group (we’ve typically used it with class sizes of around 20) and can take about an hour.

We have also used the game in much larger groups as a small part of a session, taking 10-15 minutes. In this case, students are divided into groups and a pre-completed board (see file: “Adapted Antibiotic Board Game” for example) is provided to each group. After explanation of the concepts, each group competes to be the first to successfully bring a drug to market without going bankrupt.