Figuring Out How Viruses Invade Cells

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Each year as many as one in five Americans get the flu. More than 200,000 end up in the hospital for complications, and 36,000 die from flu-related causes. And those statistics are for only one family of viruses.

Ben O'Shaughnessy and his team are figuring out how viruses invade cells so they can help develop anti-viral drugs to prevent diseases like the flu and AIDS. Like detectives, they're tracking down how viruses break through their own wall-like membranes and those of healthy cells. That is, how do they open up their own barrier and that of the cell they're trying to attack? A virus uses a finger-like protrusion to poke a hole in the cell it is attacking.

The long-term goal of this research is to keep the virus from invading (most likely through preventing the fusion of the virus and healthy cell walls), and then to come up with virus-fighting medications. These drugs are especially important for infections such as AIDS, Ebola hemorrhagic fever, and dengue fever, which have no vaccine.

The research may also help the search for effective anti-viral drugs to treat viral diseases such as flu. While flu vaccines exist, they are imperfect as flu viruses mutate rapidly, which makes it difficult for scientists to decide on the best cocktail to protect against the strains that will appear each November. There is particular urgency to develop anti-viral drugs to protect people from both "regular" flu and from H1N1 or "swine" flu.

The National Institutes of Health awarded O'Shaughnessy a $1.5 million grant in 2010 for a project that takes a closer look at a process essential to all life: cell division. His team is investigating how a muscle-like ring inside the cell is assembled and how it works on a molecular level to complete the closure as the cell physically splits, a process called cytokinesis.

"We are mathematically modeling this machine to establish a quantitative understanding of how it works," he said. The research has potentially far-reaching implications.

"Failed or improper cytokinesis due to improper ring constriction can result in cells with zero or many copies of the genome," O'Shaughnessy added. "Understanding the mechanism of cytokinesis is essential to help combat cancer, neurological disease, and birth defects associated with such failed cytokinesis."

O'Shaughnessy teaches Molecular Phenomena in Chemical Engineering to undergraduates and Statistical Mechanics and Topics in Biology for Physical Scientists and Engineers to graduate students.

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