With the generous support of MIT alum Mr. Mohammed Jameel, and named in honor of Nobel Peace Prize winner Muhammad Yunus, we are pleased to be launching a new challenge to students throughout the Institute. The objective of the challenge is to harness the energy and inventiveness of MIT students to help solve the problems faced by some of the poorest communities around the world. Every year the Yunus Challenge will focus on a particular problem faced by specific communities. The problem will be chosen with input from groups and individuals working with poor communities around the world. Students will be provided with background information on the issue, as well as chances to visit, learn from, and work with relevant communities as they work to develop solutions.

**2006/2007 Yunus Challenge Topic**

“Increasing Adherence to Tuberculosis Drugs in Rural Developing Country Contexts”

Adherence to medication regimens—the extent to which patients take the drugs they are prescribed—is estimated at only 50% worldwide. This surprisingly common problem is the cause of both individual treatment failure and public health problems across a wide range of diseases and countries.

For this year’s Yunus Challenge, we will focus on tuberculosis (TB). TB kills 1.7 million people a year, yet the vast majority of cases are curable. Adherence to TB drugs is low and is a major driver of the epidemic. The most successful program geared to increase TB drug adherence, Directly Observed Therapy, Short-Course (DOTS) is relatively expensive and, in 2002, was available only to approximately 37% of people with TB.

**Potential Issues to Consider**

Factors causing low adherence to TB drugs include:

- Forgetfulness
- Procrastination
- Side-effects of TB drugs
- Alleviation of symptoms before the end of prescribed course of treatment

**Criteria for This Year’s Challenge**

The Yunus Challenge IDEAS Award for 2006/2007 will be given to the team that creates a system that solves as many of the problems as possible that cause non-adherence to TB drugs in rural, developing country contexts, for the smallest cost possible. The issues considered may include, but should not necessarily be limited to, those listed above. The system may involve a physical device, but that is not required. In judging between proposals, credit will be given for feasibility, acceptability within the community (i.e. likelihood of adoption), and supporting rationale for how it will address the problem of adherence. For example, the rationale could include reasoning on why the team decided to focus particular attention on solving one of the four issues. If a team decides that non-adherence is actually due to some other factor, supporting evidence should be given.

Because the challenge is to improve adherence where DOTS is not being implemented due to cost, systems should aim to come in at a significantly lower cost than DOTS in
their entirety, including all costs of system administration and any manufacturing costs. Even below this threshold, cost will continue to be an important criteria in judging—i.e. the cheaper the better.

The system should be designed to operate in conditions prevalent in rural communities in poor countries as these present a major challenge for DOTS. Participants are encouraged to work on a design with a specific community or region in mind as this can be helpful in identifying constraints and providing context. One contextual issue that contestants should keep in mind is that medical personnel have very high rates of absence in rural (and often urban) settings across the developing world (see background information). This is not just a problem for medical service providers. Systems that require regular attendance of individuals that are not accompanied by good monitoring processes often fail in this context.

**Supporting Initiatives for Potential Contestants**

Opportunities will be provided to groups of students wanting to learn more about the challenge and the context in which any solution must operate. These will be provided through D-Lab class visits and individual fellowships through the Public Service Center. This year, some students enrolled in the D-Lab class will visit communities facing the challenge of non-adherence to TB medication in rural India. They will visit and work with a nongovernmental organization that has been dealing with these issues for many years. In addition, students are encouraged to apply for Fellowships which provide students working on a potential solution to visit and work with communities to work on developing a feasible solution which takes local context into account. These opportunities are again made possible through the generous support of MIT alumnus, Mr. Mohammed Jameel. Teams may enter their proposals into the IDEAS Competition, where a special award has been created to provide the winning team with funding to pursue their ideas.

**Contact Information**

For further information, please contact Alison Hynd (hynd@mit.edu).
Background and Preliminary Readings on Tuberculosis and Drug Adherence

The Global Burden of Tuberculosis
Tuberculosis (TB) is the second-leading cause of death by infectious disease in the world, behind HIV/AIDS. Each year, 1.7 million people die of TB. Like HIV/AIDS and malaria, TB is also a "disease of the poor": 95% of people afflicted with TB and 98% of the people who die from TB are found in developing countries, and patients with TB in developed countries are disproportionately poor. The majority of TB sufferers are between the ages of 15 and 45 years of age, resulting in large economic costs in lost productivity from TB mortality and morbidity.

Preliminary Readings:
• World Health Organization TB publications can be found at: http://www.who.int/tb/publications/en/

Drug Adherence
Poor drug adherence has been documented across widely varying drug regimens, diseases and cultural contexts. Experts have suggested that adherence rates across all contexts are approximately 50%, and that high adherence to drug regimens in any context is relatively rare. Although recognized as a significant barrier to public health, there is a lack of consensus on effective approaches to solving the adherence problem.

Preliminary Readings:

TB and Drug Resistance
Poor adherence to TB drugs is a significant cause of the development of resistant strains of TB. Multi-drug resistant strains of TB (MDR-TB) are resistant to first-line TB drugs and strains of extreme drug-resistant TB (XDR-TB) are resistant to both first- and second-line drugs. Approximately 425,000 new cases of MDR-TB are identified each year, and alarming rates of XDR-TB have recently been reported. Treatment of MDR-TB is much more expensive than treatment of non-MDR-TB, and XDR-TB is particularly alarming because of the lack of treatment options for patients infected.

Preliminary Readings:
The DOTS strategy
As a response to TB adherence problems, the World Health Organization (WHO) currently recommends the Directly Observed Therapy, Short-Course (DOTS) strategy. Part of this strategy is the direct observation of patients taking their medication by a health worker. DOTS has proven to be very successful in some contexts, such as China’s rapid DOTS rollout in the 1990’s. However, partly because of the relatively high cost of the program, in 2002 DOTS only covered an estimated 37% of reported TB cases. Scaling up of DOTS has a central role in the WHO’s plan to combat TB to meet targets set by Millenium Development Goals by 2015, but many people infected with TB will not have access to a DOTS program for years to come.

Preliminary Readings:
- World Health Organization publications on the DOTS strategy can be found at: http://www.who.int/tb/publications/en/

Procrastination and Adherence
Research in economics has suggested that people may procrastinate because of a tendency to devalue the future relative to the present. Such procrastination may be an explanation for a patient’s not taking pills each day, or not going to the clinic to refill their prescription. There may be ways to reduce procrastination; for example, small financial incentives have been shown to increase the percentage of people who pick up their results from HIV tests in Malawi, and a simple planning intervention has been shown to cause a large increase the number of college students who show up for tetanus shots.

Preliminary Readings:

Low Attendance of Health Care Professionals
Low attendance of health care professionals at clinics in developing countries has been widely documented. This low attendance may affect patient adherence directly: for example, a patient may be unable to get a refill of TB medication if the health care provider is unavailable. Moreover, low attendance of health care providers is an important factor to consider in any intervention that deals with medication adherence.

Preliminary Readings: