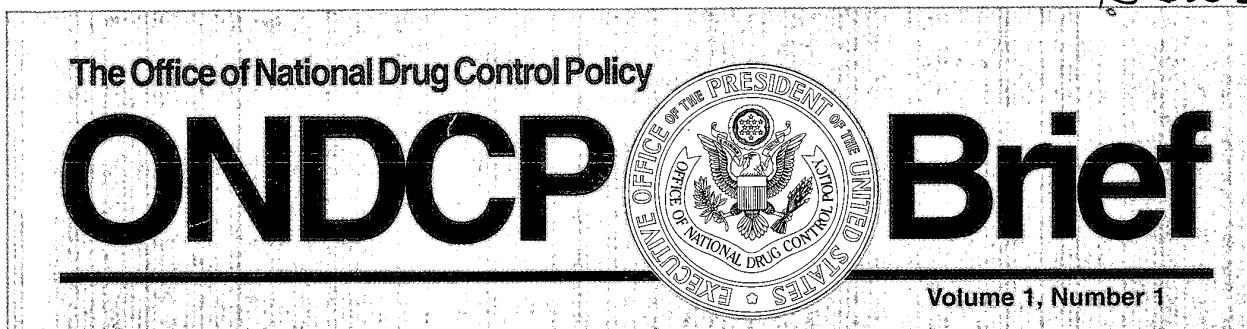


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# Demand Reduction Technologies

## Enzymes Stop Effects of Cocaine

"Crack" cocaine is a uniquely difficult drug to combat. Cocaine addiction afflicts the abuser with a powerful reinforcing potential which renders cocaine abuse particularly resistant to treatment.

The Office of National Drug Control Policy (ONDCP), Counterdrug Technology Assessment Center (CTAC) has investigated the scientific reasons why crack is so addictive, and what can be done about it. Through CTAC projects, scientists are learning how cocaine consumption is reinforced and ultimately becomes addictive. Though not injected, crack cocaine enters the blood stream very quickly in very large quantities. The fact that the amount dissolved in the blood rises almost as quickly as if it were injected is one reason why it is so dangerous, so addicting and, like other forms of cocaine, so extremely resistant to treatment. Armed with this

### CTAC's Role

The Counterdrug Technology Assessment Center (CTAC) was created by Congress to provide scientific and technological support to agencies involved in our Nation's battle against drug abuse. As a part of the Office of National Drug Control Policy (ONDCP), CTAC serves Federal agencies, State and local governments, as well as civic and community organizations. Originally created with the goal of assisting the law enforcement community, CTAC now provides technological support to drug prevention and treatment agencies as well. This *ONDCP Brief* is a summary of CTAC initiatives in demand reduction.

knowledge, ONDCP is now funding advanced research to block these effects.

CTAC is sponsoring an innovative project at the College of Physicians and Surgeons at Columbia University. It is hoped that researchers can discover and make an artificial enzyme that will protect the body from the addicting effects of cocaine. If an enzyme can be discovered that attacks and destroys cocaine after it enters the body, but before it

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*"This enzyme would deprive the cocaine abuser of the behavioral reinforcing effect of the drug and could last up to three weeks for each immunization."*

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destroys cocaine after it enters the body, but before it

## Contents

- Brain Scanning Now Possible Through New Technology ..... 3
- Drug Evaluation Network System ..... 4
- Supporting the Forensic Science Community ..... 5
- Coordinating the Research ..... 6

### How Would the Enzyme Work? A Technical Explanation

CTAC hopes to someday immunize addicts from the effects of cocaine. Catalytic antibodies are artificial enzymes elicited by immunization with a stable analog of the transition-state for a reaction. Cocaine can be metabolically deactivated by hydrolysis at its benzoyl ester group and an analog designed to mimic the transition-state of this ester hydrolysis reaction will elicit antibodies that can act as highly specific hydrolyses against cocaine. Such catalytic antibodies directed against cocaine would bind, hydrolyze and deactivate cocaine and thus would free them for further binding. To date, three antibodies have demonstrated hydrolytic activity against cocaine.

enters the brain, we will be able to "immunize" people against cocaine for weeks at a time. This enzyme would deprive the cocaine abuser of the behavioral reinforcing effect of the drug and could last up to three weeks for each immunization.

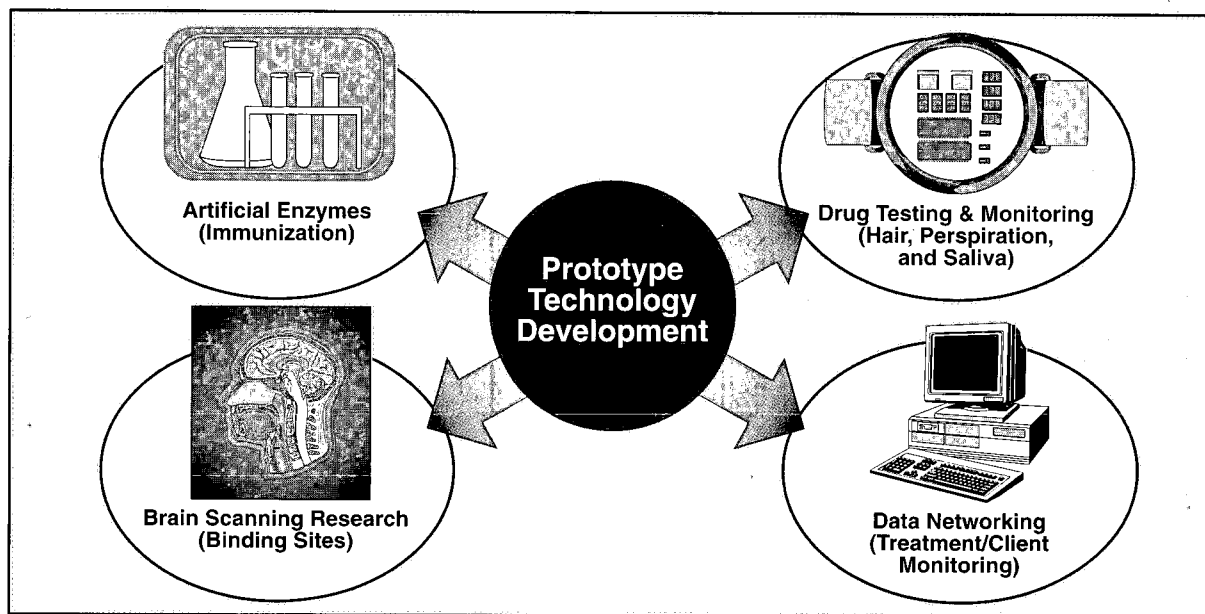
Recent accomplishments have included the cloning of the gene which enables the drug to act upon humans. Work is now underway to form a gene which will help scientists to determine how

cocaine can be blocked. Once this is determined, new agents can be made to stop the effects of cocaine without interfering with normal body functions.

### Drug Testing For Prevention and Treatment

As part of ONDCP's goal to expand prevention and treatment across the Nation, CTAC is sponsoring a comprehensive study of alternative drug testing technologies. A joint effort of the Naval Research Laboratory and the Jet Propulsion Laboratory is examining new techniques that test for the presence of drugs in hair, saliva, and perspiration. The New Orleans District Attorney's Office is serving as the project's law enforcement test site, where drug testing is now being used in the local diversion program. When fully developed, this detection methodology would complement current urinalysis tests.

Once a model technology is identified, researchers will work to create an antibody based detection system, which would be worn next to the skin. A central monitoring station may be notified by a device which detect drugs by analyzing perspiration. Such a system could then be used to determine whether a parolee or a person on home detention ingests illicit drugs.



*Current science projects to support prevention and treatment*

## Brain Scanning Advances Research on Addiction

CTAC has funded an innovative project at the Addiction Research Center, an independent laboratory operated under the authority of the National Institute of Drug Abuse (NIDA), of the U.S. Department of Health and Human Services. The purpose of this CTAC project is to conduct research on the causes and treatment of drug addiction.

To carry out the new ONDCP treatment initiatives, CTAC has formed a unique partnership with the Addiction Research Center, and an innovative project is now underway.

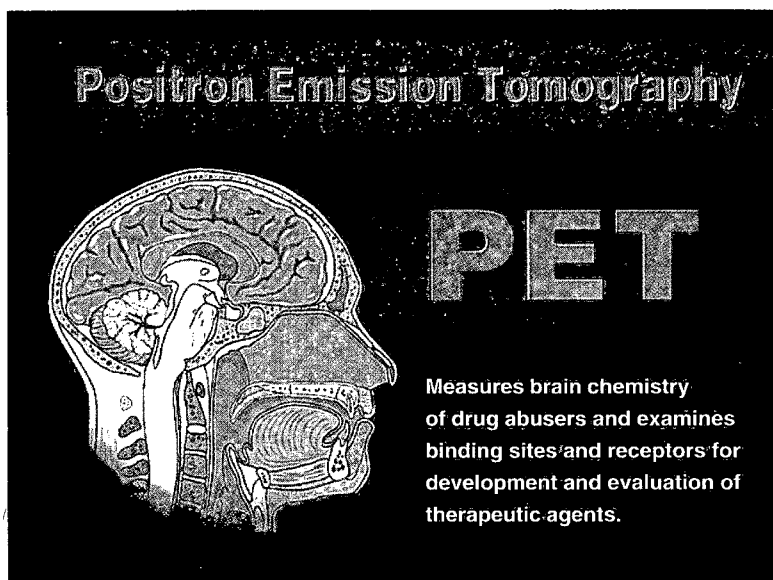
It is now possible to make highly resolved, accurate measurements of brain biochemistry in living humans. To measure the effect of drugs on the human brain, CTAC is working with a new technology, Positron Emission Tomography (PET). PET provides neuroscientists with unique, previously unattainable abilities to measure brain biochemistry. PET is used to determine which areas of the brain are activated by various drugs of abuse. This technology provides a powerful new diagnostic imaging system to assist scientists in addiction studies.

### Defense Technology Benefits Drug Treatment

Working with the Department of Defense, CTAC has identified technologies which may be converted to domestic applications in such priority areas as drug treatment.

Positron Emission Tomography (PET) has been developed from nuclear interrogation techniques originally developed for military purposes. CTAC has worked with scientists to adapt this technology to several innovative uses. Another *ONDCP Brief* will highlight CTAC efforts to apply this technology to cargo inspection.

Treatment researchers at the Addiction Research Center are now testing the PET technology to scan the human brain and study effects of illicit drugs. As shown in this *ONDCP Brief*, PET may ultimately assist CTAC to develop enzymes which block the addictive effects of illicit drugs.



*Positron Emission Tomography: CTAC helps to convert a defense technology for use in drug treatment*

CTAC's funding at the Addiction Research Center will be used to develop radioisotope tracers and advance PET technology. PET will allow substance abuse researchers to measure brain chemistry of people under the influence of drugs. The PET facility being outfitted at the Addiction Research Center is the only Federal facility of its kind dedicated solely to drug abuse research.

With this new technology, potential therapeutic drugs can be evaluated. PET will measure the effects of new agents on the regions of the brain known to be activated by drugs of abuse. CTAC hopes this will greatly increase the speed with which new therapeutic agents can be developed.

### New Isotopes Help Research Laboratories

Building on recent advances at the Addiction Research Center, CTAC is also working to discover the causes and physiological effects of drug abuse. This effort focuses on production of isotopes, compounds used as markers in the human body, allowing scientists to trace certain effects on the body's organs and systems. CTAC plans to develop new isotopes that may help us understand an individual's vulnerability to drug abuse. Researchers will focus on changes in brain

### The *ONDCP Brief*

The Office of National Drug Control Policy (ONDCP) is creating a new series of publications called the *ONDCP Brief*. The goal of the *ONDCP Brief* is to place current drug-related information into those hands that need it, as rapidly as possible. The *ONDCP Brief* will be topical in nature, but topics covered will comprise the entire scope of ONDCP's mission.

chemistry and mood-altering effects of addictive drugs and medications to treat drug abuse. Initial plans include the fabrication of a radiochemistry laboratory for the preparation of the materials for injection on site.

### Drug Evaluation Network System

Drug treatment programs and law enforcement agencies can greatly benefit from current scientific advances, but they must receive current and accurate information in order for technology to help at all. For this reason, CTAC is working to establish a computer network to link data collection for drug treatment programs. This effort is called the Drug Evaluation Network System (DENS).

For the first time, it will bring together data and allow researchers access to a wider range of statistical data. Part of the Information Superhighway, DENS will link drug treatment centers around the country to facilitate information exchange. Registered providers can then determine if similar drug treatment cases are occurring elsewhere, and examine the treatment methodologies employed. DENS will enable treatment agencies to review the success or failure of treatment methods, and expedite use of successful treatment strategies.

This three year project will identify treatment centers for test-

ing of the prototype system. As a state-of-the-art system, DENS will integrate applications, hardware, software and database applications, including a multimedia treatment information file server.

An important goal is to incorporate research results into the system. Where it is not already in an electronic format, data will be converted into a digital form for rapid electronic search and retrieval. The prototype system will use both Internet terminals and advanced workstations capable of two-way audio and video.

DENS will enable drug treatment centers to collaborate on studies and experiments. Demographic characteristics and treatment information for patients can be entered into the system allowing treatment studies to be performed using the most current information. Electronically connected treatment centers around the country will be able to quickly access critical information around the clock.

A significant benefit of DENS will be the electronic link it creates between the substance abuse research community and nationwide treatment centers. This link will benefit both research progress and the effectiveness of treatment programs.



*The Drug Evaluation Network System brings together technologies to form a computer network linking research and treatment communities*

## CTAC Provides Forensics Support

In cooperation with the Federal, State, and local officials, CTAC is sponsoring a system of competitive contracts to support forensic research and development. The goal of this effort is to develop high priority forensic analyses, methodologies, and instruments that substantially advance our ability to process scientific evidence in support of drug investigations. This effort benefits both demand reduction and supply reduction programs.

Since forensic research is crucial to advance the science most used in investigations and courts, the FBI and CTAC are working together to strengthen forensic research and development.

Each project targets technology for practical use, encouraging partnerships between forensic laboratories, universities, research institutes, scientific companies, and engineering firms.

## Surface-Enhanced Raman Spectrometer

The goal of the Surface-Enhanced Raman Spectrometer (SERS) program is to develop a rapid and convenient system for detecting trace quantities of illicit drugs on the body. When fully operational, SERS will allow rapid detection of illegal drugs and will be especially applicable to parole, probation and law enforcement agencies.

Initial efforts will focus on detection methods for cocaine and heroin. The SERS technology will ultimately be part of a device for electronically detecting drugs. It will be used by health professionals as well as justice personnel. SERS may also be used for border security and inspection facilities.

***"The SERS technology will ultimately be part of a device for electronic transmission of drug detection by treatment, corrections, and police personnel."***

### CTAC PLAN: DEMAND REDUCTION RESEARCH

<b>Purpose:</b>	To develop appropriate drug testing methods for prevention and treatment
<b>Approach:</b>	Detection of drugs in hair, saliva, and sweat
<b>Site:</b>	Naval Research Laboratory and Jet Propulsion Laboratory
<b>Purpose:</b>	To determine the causes and physiological effects of drug abuse
<b>Approach:</b>	Drug abuse brain scanning with Positron Emission Tomography
<b>Site:</b>	National Institute on Drug Abuse, Addiction Research Center
<b>Purpose:</b>	To develop cocaine catalytic antibodies
<b>Approach:</b>	Developing an antibody to detect and destroy cocaine
<b>Site:</b>	Columbia University, College of Physicians and Surgeons
<b>Purpose:</b>	To implement a Drug Evaluation Network System
<b>Approach:</b>	Electronically linking drug treatment and research centers
<b>Site:</b>	Columbia University, Center for Alcohol and Substance Abuse (CASA)
<b>Purpose:</b>	To develop a field-usable detection method for illicit drugs
<b>Approach:</b>	Detecting drugs with a Surface-Enhanced Raman Spectrometer
<b>Site:</b>	U.S. Navy and Gamma-Metrics

As the first important step toward this goal, CTAC is sponsoring scientists to develop the laboratory techniques required to identify and isolate cocaine and heroin in laboratory samples. Corresponding software and chemical libraries are also being developed.

## Field Test Kits

In cooperation with CTAC, the FBI Laboratory has developed field test kits to detect drugs on hands and other surfaces. Although originally developed for law enforcement agencies, this de-

vice will greatly benefit treatment agencies across the nation.

This technology may be used for detecting drugs encased in other substances, and is the only tech-

nology that enables drug detection in molded plastic items. Through the FBI/CTAC partnership, 500 prototype field test kits have been distributed.

For either treatment, corrections or law enforcement, this technology uses antibodies to detect illicit drugs. Prototype field testing will help

*"This is the only technology that enables drug detection in molded plastic items ... 500 prototype field test kits have been distributed."*

### Field Test Kit Used In Asset Seizure

During the recent evaluation of a CTAC drug testing kit, the technology led to a six million dollar seizure by the FBI.

The FBI was testing CTAC field kits for identification of trace evidence. The new device played a key role in the investigation by leading FBI agents to the suspects who were ultimately arrested and prosecuted.

The technology used in this case is also available to health professionals and those who work in drug treatment. For example, parole and probation officers may use this device to confirm that clients are drug-free.

scientists to optimize the antibodies used, and to improve test reliability. When fully tested and ready for use, this field test kit will provide agencies an accurate and low cost drug detection system superior to current technologies.

Through these technological advances sponsored by CTAC, both health and justice agencies will have a valuable new tool for use in their continuing efforts to combat drug abuse.

## Coordination of Research

The CTAC director serves as the Chief Scientist of ONDCP. In this role, he provides the staff support to the Director of ONDCP who chairs the Research, Data, and Evaluation Committee.

### The CTAC Mission

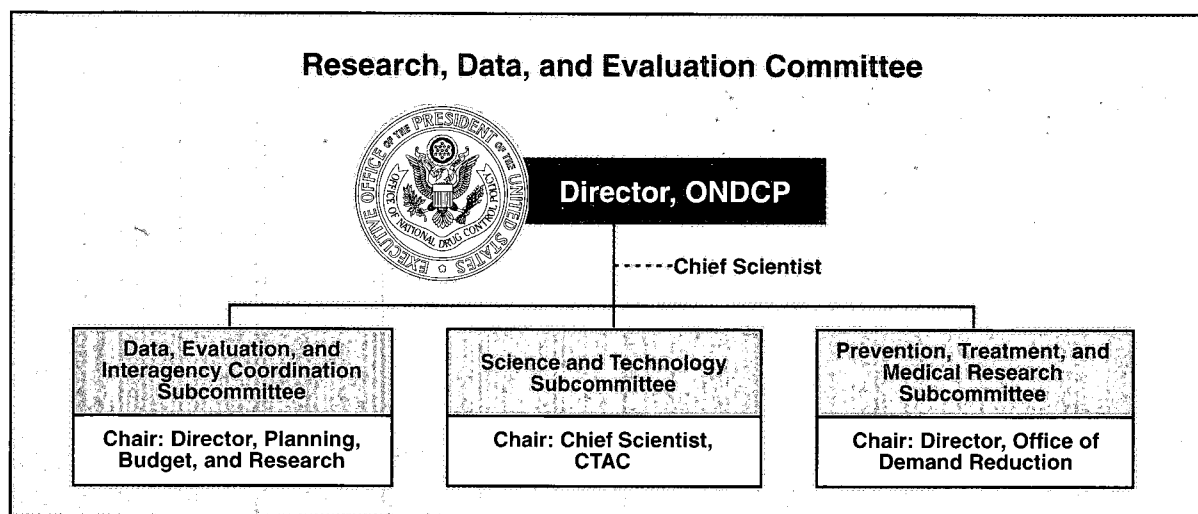
CTAC serves as a technology coordinator, working with representatives from Federal, State, local and community agencies to identify counterdrug technology priorities. As part of this effort, CTAC has established technology testbeds at centralized locations where counterdrug technologies may be tested in an operational environment. To date, CTAC has coordinated technological assistance in four broad areas.

**Demand Reduction:** To expand treatment capacities and prevention capabilities through innovative applications of technology.

**Law Enforcement Technologies:** To develop prototype equipment to support daily tactical operations against drug trafficking organizations.

**Nonintrusive Cargo Inspection:** To develop a rapid, modern automatic system to inspect vehicles, shipments, and cargo containers without physically removing contents for manual inspection.

**Wide Area Surveillance:** To develop prototype technology to detect drug trafficking, including aircraft, rail, ships, motor vehicles.



*The ONDCP Research, Data, and Evaluation Committee identifies and evaluates drug-related technological needs for research*

Congress has directed ONDCP to coordinate the drug-related research data and evaluation efforts of Federal agencies. For the first time, ONDCP is forging a comprehensive approach to demand reduction, and technology will be an important linkage between related Federal agencies. At the direction of ONDCP, CTAC will continue to support future projects and strengthen the technologies which advance drug prevention and treatment. As noted in the National Drug Control Strategy, this goal will be accomplished through the commitment and teamwork of Federal, State and local officials.

The Science and Technology Subcommittee examines drug-related technological issues from all aspects and coordinates these efforts with all concerned agencies. The subcommittee also evaluates drug-related Federal research proposals to determine whether the projects will have a high probability of success.

***"... ONDCP is forging a comprehensive approach to demand reduction, and technology will be an important linkage between related Federal agencies."***

### CTAC Annual "Blueprint"

Each year, CTAC has published an annual report entitled, "Counterdrug Research and Development Blueprint." The first issue was released in August 1992, and the second in October 1993. These reports describe the technology and goals of CTAC to the technical community.

The *ONDCP Brief* will now complement the "Blueprint" for counterdrug technology by providing topical discussions for the general public. In this way, ONDCP will highlight CTAC efforts more frequently.

*ONDCP Briefs* are being sent to a wide audience of Federal, State, and local officials; treatment and prevention program sponsors; and criminal justice professionals.

ONDCP and CTAC have established the following research, data, and evaluation goals:

- Coordinate Federal research efforts;
- Ensure that key Federal research efforts receive support and priority; and
- Focus research efforts on projects that have a high probability of both immediate and long-term cost effectiveness.

CTAC seeks to advance technology by building partnerships between the scientific community and the health and justice agencies which serve on the front lines of the battle against drug abuse.

## The CTAC Mission

The Counterdrug Technology Assessment Center (CTAC) was created by Federal legislation.

CTAC was created by the Counternarcotics Technology Act of 1990 (Public Law 101-510) and placed within the Office of National Drug Control Policy (ONDCP) where the chief scientist serves as an advisor to ONDCP.

Congress has given to CTAC responsibility for coordination of multi-agency counterdrug research and development efforts. CTAC's primary responsibilities are to prevent duplication wherever possible and to coordinate the work of multiple agencies. CTAC is also provided funding for special research and development projects which span across the interests of individual agencies.

Congress has directed the following three-step process for the development and implementation of a national counterdrug R&D program.

- Identify the short, medium, and long-term technological needs of Federal, State, and local law enforcement agencies.
- Develop a specific and comprehensive counterdrug R&D strategy that prioritizes such needs according to technical and financial feasibility and includes a plan to develop and test high-priority technology projects.
- Oversee, strategically coordinate, and implement the R&D strategy of all civilian and military agencies in the Federal government conducting counterdrug R&D.

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