SANDIA REPORT

SAND2000-0566

Unlimited Release

Printed March 2000

RECEIVED
MAR 20 2000
OSTI

Computer Aided Differential Diagnosis in Emergency Situations (CADDIES) System

William P. Noel

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

Sandia is a multiprogram laboratory operated by Sandia Corporation,
a Lockheed Martin Company, for the United States Department of
Energy under Contract DE-AC04-94AL85000.

Approved for public release; further dissemination unlimited.

Sandia National Laboratories

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

SAND2000-0566
Unlimited Release
Printed March 2000

Computer Aided Differential Diagnosis In Emergency Situations (CADDIES) System

William P. Noel, EMT-B, SN
Neutron Tube Development Division
Sandia National Laboratories
P.O. Box 5800
Albuquerque, New Mexico 87185-0516

Abstract

This report presents an idea for a portable computerized differential diagnosis tool that could be utilized by a health care provider during an emergency situation. This radio frequency, networked, menu driven system would analyze various patient assessment parameters and make recommendations regarding possible diagnoses/treatment options outside the scope of suspicion of the health care provider. This system would serve as a repository for initial epidemiological data and assist the health care provider with spotting emerging trends.

Contents

ABSTRACT	1
CONTENTS	2
INTRODUCTION	3
OVERVIEW OF THE COMPUTER AIDED DIFFERENTIAL DIAGNOSIS IN EMERGENCY SITUATIONS (CADDIES) SYSTEM.....	3
SOFTWARE / HARDWARE	4
ESTIMATED DEVELOPMENT COSTS	7

Introduction

A trip to the emergency room at a local hospital typically results in the patient seeing an emergency room doctor. This doctor, whether a head of the department, a resident, or an intern relies on the experience and knowledge base gained to make the correct diagnoses. In most situations this experience base is adequate to meet the needs of the patient. However, in the event of a terrorist incident, whether it is nuclear, biological or chemical (NBC) the physician most likely has a limited experience base to draw upon.

Many physicians in practice have never diagnosed a chemical/biological causality. In the event of a terrorist incident the rapid diagnosis of the causality will be critical in the successful management of the case. In the case of a biological incident, anthrax, smallpox, botulism, or plague can be managed if the organism is identified rapidly and treatment is initiated during the prodromal stage. Time is of the essence for causalities of a chemical attack. Many of the chemical agents have latent periods of less than 2 hours, depending on the concentration of exposure. The causality that presents only mildly symptomatic could very well require intensive care support in a very short time. Rapid diagnosis of a chemical event is of extreme importance not only for the casualty but also for the safety of the health care providers and the health care facility.

The CADDIES system would assist the health care provider with the rapid and correct diagnoses of the chemical/biological agents used by terrorist. This would lead to a quicker treatment for the patient and the mobilization of municipal, state and federal response sooner, thus possibly saving lives and preserving valuable evidence for prosecution.

Overview of the Computer Aided Differential Diagnosis In Emergency Situations (CADDIES) System

The CADDIES system is envisioned to be a portable computerized system that accepts inputs of patient assessment parameters and displays possible diagnoses that should be considered in the differential diagnosis. The principle advantage of the system is the experience base the attending health care provider is complemented, and the patient gets the correct diagnosis and the correct treatment in the shortest period of time possible. The CADDIES system is not intended to take over the diagnosis role of the health care provider but to augment the health care provider with additional information.

The CADDIES system would be a portable; battery operated microprocessor system using an input device of pen (or pointer). Similar to a touch screen on some personal data assistants (PDA). Ease of use would be critical in the acceptance by the health care providers. The menu structure would be intuitive, requiring little or no training on the operation of the system.

The health care provider would input the salient assessment findings regarding the patient using a menu driven system with pull down menus and the CADDIES system would,

using a high frequency data link to a main data analysis/repository computer, analyze the patient assessment parameters and display possible diagnosis. The health care provider would have a limited amount of information that would be entered alphanumerically since most of the data would be input using drop down menus.

The Caddies system would then present the health care provider a list of possible diagnoses to be considered in the differential. The health care provider is then free to accept or reject the data provided by the CADDIES system. However, if the health care provider chooses to accept the recommendation of the CADDIES system the health care provider could be prompted for addition information depending on the selected diagnosis.

In the case of a possible infections or chemical agent that could have terrorist potential, the CADDIES system would prompt the health care provider for additional information such as patient assessment parameters or an "mini" epidemiological "debrief" prior to total disability. Once the diagnosis is selected the CADDIES system, would also report similar cases in the previous 2 hours, 8 hours, 24 hours, and 48 hours that have presented at the health care facility. A citywide integrated CADDIES system could report from multiple health care facilities, thus indicating a much broader picture of the terrorist incident. This would give the emergency health care provider addition information that may indicate the need for the activation of the local disaster plan and the notification of appropriate individuals / organizations that the health care facility deems necessary to protect community health.

Software / Hardware

Operation of the CADDIES system is via a menu system. The main screen would be "top level" categories of information. It is important that the entire process of operation be intuitive and require essentially no training even for the computer novice.

Figure 1. Main Switchboard

A proof of concept system could be constructed using a relational database such as Microsoft Access. This could prove in the concept and expose any conceptual problems. The operational system would most likely run on a large relational database system such as Oracle.

As the health care provider moved down the menu tree the menu selection would become more specific until the causality assessment data menu would be entered.

Figure 2. Assessment Data Menu

After the type of assessment data selected from the previous screen the health care provider would come to the data entry menu. The assessment parameters would be input and the data would be transmitted to the main analysis computer via a high frequency network interface. Pertinent assessment parameters used by the CADDIES system would be selected through a collaborative effort with the using health care providers.

 A screenshot of a Microsoft Access window titled "Microsoft Access - [Employees]". The window has a menu bar (File, Edit, View, Insert, Format, Records, Tools, Window, Help) and a toolbar. The main area displays a data entry form with a table structure:

Employee ID	(AutoNumber)	Other
Respiration Rate		Other
Blood Pressure		Other
Heart Rate		Other
Pupils		Other
Pain		Other
Temperature		Other
Other		Other

 Below the table, there is a "Record" field showing "14" and a "Form View" status bar at the bottom with "FLTR" and "NUM".

Figure 3. Input Screen – Assessment Data

The CADDIES system could be constructed from off-the-shelf hardware that is commercially available today. The operating software would be standard commercial software with customized queries for the database analysis. After the causality assessment parameters are input the CADDIES system then analysis the data a makes possible diagnoses that should be considered.

Patient ID	Diagnosis	Accept	Reject
		Accept	Reject
		Accept	Reject
		Accept	Reject
		Accept	Reject
		Accept	Reject
		Accept	Reject

Figure 4. Possible Diagnoses

Should one of the diagnoses made by the CADDIES system be accepted the health care provider would be prompted with additional information input, treatment modalities, and the epidemiological data regarding past cases with the same diagnoses.

Patient ID	Treatment	Additional Data	Epi Data Input	Similar Diagnosis	Accept

Figure 5. Diagnosis Information Page

The ultimate goal of the CADDIED system is to provide the correct care to the causality in the shortest possible time and to allow the health care provider to identify emerging epidemiological trends of diseases such that the appropriate agencies can be mobilized.

Estimated Development Costs

Development of the CADDIES system is estimated be modest. All hardware would be commercial, off the shelf equipment requiring little modification for fielding. The major cost of the CADDIES system would be the development of the database, system of queries and the initial database of diseases. It is estimated that a single station prototype system could be fielded in 2 years for a development cost of approximately \$525,000. An additional development cost for \$500,000 would be required to make the system fully operational.

	Year 1	Year 2
Hardware acquisition	\$50,000	
Software acquisition	\$75,000	
Software development	\$200,000	\$200,000
Total Costs	\$325,000	\$200,000

Distribution:

1	MS 0516	G.L. Laughlin, 2564
1	MS 0516	R.J. Koss, 2564
10	MS 0516	W.P. Noel, 2564
1	MS 9018	Central Technical Files, 8940-2
2	MS 0899	Technical Library, 4916
1	MS 0612	Review and Approval Desk, 4912
		For DOE/OSTI