AIDS TO DECISIONMAKING IN POLICE PATROL:
AN OVERVIEW OF STUDY FINDINGS

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*Views and conclusions expressed in this paper are those of the authors. They should not be interpreted as representing the official opinion or policy of The RAND Corporation, or of the U.S. Department of Housing and Urban Development, which sponsored portions of this study.

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An Overview of Study Findings

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Over the past several years, reported crime and the fear of crime have increased sharply in the United States. These phenomena, together with others, have focused attention on the police and their role in society. As a nation, we spend annually over $5 billion on the criminal justice system. More than 40,000 police agencies account for over $2.5 billion, greater than 50 percent of the total. Well over $1.0 billion is allocated to police patrol—the heart of police law enforcement.  

With increasing demands on limited local government funds, there is a growing need for effective aids to decisionmaking in determining:

- Proper patrol force strength
- Equitable and effective distribution of patrol services by police district and tour of duty
- Effective operational policies and tactics for police patrol

This paper summarizes the findings of a five-month study of police patrol conducted as part of a broader study on the allocation and deployment of municipal services. Financial support for the work was provided by the U.S. Department of Housing and Urban Development, and by The Rand Corporation.

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2 The full study is reported in *Rand Corporation Report R-593-HUD/RC, Aids to Decisionmaking in Police Patrol*, which is available on request. It includes a description and comparison of the current allocation of police patrol resources in six major police jurisdictions; a statistical analysis of crime, police resources, and demographic data in several cities; a discussion and recommendations regarding criteria for evaluating the effectiveness and equity of the deployment of police patrol services; a description of the state of the art of patrol allocation methods, with recommendations for change in current methods; and an identification of some important problem areas and knowledge deficiencies that might benefit from research and experimentation.

A companion volume, *Rand Corporation Report R-594-HUD/RC, Aids to Decisionmaking in Police Patrol: Survey Results*, contains the detailed responses elicited by questionnaire and personal visits to six major
The goal of this study was to provide a coherent, unified overview of certain decisionmaking aids currently and potentially available to police in addressing the three major patrol issues given above. In pursuing such a goal our objectives were threefold: to synthesize aspects of previous work relevant to the three basic patrol issues posed; to build upon it; and to indicate clearly the research and experimentation still needed to bridge basic knowledge gaps.

Prior work by the Presidential Crime Commission in 1966-1967 structured in a general way many of the problems confronting decisionmakers in the criminal justice system, thereby providing a framework for much of the research and experimentation currently in progress. Several operationally oriented studies have recently appeared which demonstrate the feasibility and utility of quantitative analysis in police patrol decisionmaking.3

With this work as a background, then, our research plan devolved into four tasks: (1) to provide a conceptual framework and systematic discussion of evaluation criteria relevant to the three patrol issues; (2) to acquire, analyze, and compare data from several major police jurisdictions on demands for police service, current resource allocation, allocation methods and criteria currently employed, operational policies, and patrol organization; (3) to describe currently feasible improvements in certain decisionmaking aids; and (4) to discuss the basic knowledge deficiencies (related to these patrol issues) that could benefit from research and experimentation.

police jurisdictions: the Los Angeles City Police, Los Angeles County Sheriff's Department, Phoenix Police, St. Louis Metropolitan Police, and two departments who requested that they not be identified. This information forms a substantial part of the basis for R-593-HUD/RC.

We are grateful to police management in each of the six jurisdictions for the excellent cooperation we received.

CRITERIA FOR EVALUATING POLICE PATROL PROGRAMS

Fundamental to all questions of resource allocation is the careful selection of appropriate evaluation criteria. Previous work has not dealt comprehensively and systematically with this topic in relation to the three basic patrol issues. Relevant factors to consider in choosing criteria include: measurability, statistical variability, policy sensitivity, degree of acceptability to the police and the public, and degree to which program outputs, rather than resource inputs, are measured. Criteria selected should measure the effectiveness, efficiency, and equity of the level and distribution of patrol resources and services. Furthermore, they should enable all major functions of patrol to be evaluated, namely, apprehension of suspects, crime prevention and deterrence, and the patrol's accessibility and responsiveness to calls for service.

Currently, systematic evaluation of police patrol operations is frequently lacking. While police departments collect extensive data on each crime, they often fail to collect and use data that are relevant for the management and evaluation of patrol operations. In our study, we found that criteria currently employed in different jurisdictions vary widely, and include "command discretion," simple resource input measures, conglomerate hazard ratings, and the percentage of calls for service that cannot be immediately dispatched to a free patrol car.

Because of the complexity and multiplicity of functions which the police patrol performs, no single criterion appears adequate for evaluation purposes. Rather, it would be preferable for police planners to employ a set of criteria, with each criterion receiving individual attention. In employing sets of criteria, the method used should guarantee, at least, that minimally acceptable levels of patrol performance are maintained for each criterion. The improved methods proposed for addressing resource allocation issues can, in fact, handle several criteria simultaneously, guaranteeing that minimally acceptable levels of patrol performance are maintained for each. Thus, it is not appropriate to consolidate a set of criteria into one conglomerate measure by taking a weighted summation of the values of the individual criteria. All too often this latter practice may result in one or two criteria unintentionally dominating all others.

An ideal set of criteria might reflect true crime rate,\textsuperscript{4} true victimization rate,\textsuperscript{5} total social and economic impacts of crime, number of

\textsuperscript{4}Since the publication of the President's Crime Commission report, the fact that not all true (actual) crime is reported is now well known. For example, a victimization survey estimated that the actual number of forcible rapes were more than 3\(\frac{1}{2}\) times the reported number, that the actual number of aggravated assaults were twice the reported number, and that the actual number of robberies were 50 percent greater than the reported number.

\textsuperscript{5}True victimization rate is the actual number of crimes (in a given category or set of categories) per thousand population.
crimes prevented and deterred, plus criminal and public attitudes in relation to alternative police patrol programs. Unfortunately, none of these quantities can be easily and accurately measured at present. Consequently, proxy measures of effect must be employed.

The actual set of criteria employed should depend on the circumstances of the individual department, the decision issue, and the alternative patrol programs to be evaluated. Despite the difficulties of generalizing, we suggest that the following set of criteria may have wide applicability.

**A Preferred Set of Criteria for Evaluating Police Patrol Programs**

1. Patrol arrest rate, by crime category.
2. Charging rate, by crime category, with an indication of whether the patrol arrest occurred in response to a call or during preventive patrol.
3. Reported victimization rate, by crime category and citizen group.
4. Reported crime, by crime category.
5. Percentage of citizens satisfied with various aspects of patrol service.
6. Elapsed time from a call for police service until arrival of a patrol car; measured by both the average time and the percentage of response times exceeding a specified time T.
7. Preventive patrol frequency.
8. Hours of preventive patrol per "suppressible crime." Resource expended: total patrol budget, total patrol man-hours and total car-hours, plus a breakdown of each total into percentage allocated to each patrol function.

Average citywide values of the first eight criteria above could be used to judge effectiveness, while comparisons of values of criteria disaggregated by time, place, and population group could be used to judge how equitably patrol services are distributed. The relationship between resources expended (criterion 9) and the effectiveness achieved would measure the efficiency of patrol operations.

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6 The patrol arrest rate is the proportion of reported crimes for which at least one suspect is arrested by patrol.

7 The charging rate is the proportion of reported crimes for which at least one suspect is formally charged in the judiciary branch of the criminal justice system.

8 The reported victimization rate is the reported number of crimes per thousand population.

9 Preventive patrol frequency is the number of times a patrol car passes a randomly selected address per unit time.

10 Suppressible crimes are those that may be significantly deterred or prevented by police patrol activity.
POLICE PATROL PROGRAMS IN SEVERAL CITIES

Systematic discussions of evaluation criteria and the methodological aspects of patrol resource allocation are of only limited value without real data. Existing data sources were very limited. We found only two sources containing data on a large sample of cities. One is the well-known annual FBI reports of citywide serious crime rates. The other is a survey of 37 large municipal police departments conducted annually by the Kansas City Police Department. This survey contains general administrative data, including police department budgets, police strength, manning by rank, function and shift, salary, fringe benefits, and some organizational data.

But to accomplish the purposes of this study, it was necessary to collect additional detailed information from several cities. The data included: crime, calls for service and patrol deployment (by police district and tour of duty, as well as for the city as a whole); trends over time of demands for police service and patrol manning; patrol organization and operational policies; the internal police planning organizations; the uses of data and computers in police departments; criteria and methods of allocating patrol resources employed by police departments; and so on.

Limited resources restricted data gathering to six major police jurisdictions, because it was necessary to elicit responses both by questionnaire and by personal visits. The six participating departments were those of Los Angeles City, Los Angeles County, St. Louis, Phoenix, and two other cities that requested that they not be identified. The departments ranged in size from medium to large, employed a wide variety of patrol allocation techniques (including some advanced techniques), and the sample included older and densely populated, as well as newer and more sparsely populated cities.

An important, but not surprising, finding from the six-city survey is that most measures of patrol workload, police input, and demand (expressed in per capita, per policeman, per patrol car, or per square mile terms) vary widely among the six cities. For example, annual Part I crimes per capita vary from 0.03 to 0.14; police budget per capita varies between $13 and $85; uniformed patrol strength per thousand residents varies between 1.0 and 2.5; patrol cars on the street per shift per square mile vary between 0.045 and 2.7; calls for service per patrol car per shift vary between 2.5 and 11.5; annual Part I crimes per uniformed patrolman vary between 26 and 70; annual Part I plus Part II arrests per uniformed patrolman vary between 22 and 79.

Viewing the trends over the decade of the sixties, we judge that in the six cities surveyed increases in police strength or police per capita have not kept pace with increases in reported crime per capita, although they have outpaced population change. For example, in the six cities surveyed, reported Part I crime per capita has grown at least 50 percent in two cities and as much as 180 percent in two others, whereas uniformed patrolmen per capita have only increased by 12 to 43 percent.
Workload per patrolman has grown, too, but not as rapidly as reported crime per capita. Calls for service per patrolman increased by 30 to 45 percent and reported crimes per patrolman increased by 35 to 160 percent. Generally speaking, over the ten-year period, the disparities between growth in demand for police services, and growth in police resources and workloads, appear to be least in Los Angeles (City and County), and greatest in St. Louis, City "X," and City "Y."

As to organizational and operational features of police patrol, the six-city survey revealed that there are more similarities than dissimilarities among departments. All six patrol organizations exhibit similar geographical command hierarchies; decisions on basic beat assignments and reassignments during shifts of patrol resources are generally the responsibility of district commanders; dispatching operations are generally centralized; and most departments operate under an informal, rather than formal, priority policy in responding to calls for service from the public.

All the police departments surveyed operate an internal planning and research unit. The extent of the unit's influence in the department and the decisions which it affects vary from department to department. All utilize outside consultants for a variety of purposes; most frequently outside consultants study proposed organizational changes, design information, command-control, and management systems, as well as work on resource allocation and workload prediction schemes. The internal planning unit usually monitors the activities of outside consultants.

The President's Crime Commission recommended that all large police departments assemble a capable, in-house staff to do planning, research, and experimentation. We feel that this planning staff should include at least one competent civilian planner who is highly trained and experienced in operations research, cost-benefit analysis, and the use of computers. Since the overwhelming majority of departments now do not have sworn officers on the force with such qualifications, and since it is unlikely that lateral entry into the sworn force of such personnel will come about in the near future, such a planner usually must be a civilian. In addition to conducting in-house planning and research, facilitating the implementation of innovations within the department, a key in-house civilian planner could interpret police policy and needs (as articulated by top police management) in terms relevant to the consultants. Additionally, he could be invaluable in guiding, evaluating, and interpreting the work of outside consultants. To attract and retain such key civilian planning personnel, police departments should recruit from the graduate schools of better universities and from private industry and research organizations; they must pay competitive rates; and most importantly, they must provide the planner with ready access to the police chief.

All six departments use the computer as an internal management information and retrieval system for one or more of the following: arrest, crime, incident, narcotics, clearance, personnel, and traffic reporting. In addition, some departments use or plan to use the computer as an
integral part of operational information and/or command-control systems such as dispatching, wants and warrant searches, stolen vehicles files, and modus operandi (M.O.) files. However, most departments surveyed did not collect certain management data that would be extremely useful in providing relevant inputs into the major patrol allocation and tactical decisions posed above. For example, of the data necessary to estimate values for the preferred evaluation criteria discussed previously, only reported crime data are available in all cities, although reported victimization rate can be estimated from available data by crime category, but not by citizen group. Most departments simply do not know how responsive their patrol force is either in terms of various time delay components or in terms of the average percentage of calls for which a patrol car cannot be dispatched immediately. Nor do they know the distribution of preventive patrol frequency and preventive patrol per suppressible crime, the patrol arrest rate, the public's degree of satisfaction with police patrol service, or various measures of patrol resource expenditure.

We suggest that police departments should institute a systematic and reliable information system to collect these data. Only some data need be collected on a routine basis; others need only be sampled intermittently, in all districts, by hour, day, week, etc.

PATROL ALLOCATION METHODS

To be of maximum possible value, allocation methods should employ data that can be readily obtained; allocate on the basis of predicted future conditions rather than past conditions; use several evaluation criteria, so that several policy-relevant aspects of each proposed manpower allocation can be adequately evaluated; focus separately on each criterion rather than on a conglomerate measure; provide the capability of allocating and deploying resources by day, shift, and district rather than by district only; be relevant to decisions on force size and deployment for preventive patrol as well as for response to calls for service; and provide the capability of evaluating alternative operational policies, tactics, and command-control hardware.

Methods Currently in Use

Command discretion and judgment play a role in all decisions involving patrol force level, allocation and techniques. However, the character of quantitative aids, and the manner of using such aids to decision-making, varied significantly among the departments surveyed.

"Hazard formulas" are widely used for allocating manpower by time and geography. This method takes all factors thought relevant to determining the need for patrol services, weights each factor by its importance, and adds to arrive at a single hazard number. Men are then distributed in proportion to the relative hazard in an area. The hazard formula method is unsatisfactory for several reasons. The additive weighted
combination of the many hazard factors can reflect neither the highly complex interactions among the factors nor focus individual attention on any single factor. As typically used, hazard formulas reflect past conditions for a district rather than predicted future conditions for day, shift, and district. More importantly, existing hazard formulas do not relate meaningful measures of effectiveness to operational policies. Also, hazard formulas are not relevant to determining the total size of the patrol force required to satisfy certain service-level criteria.

In Phoenix, the hazard formula concept is employed in an innovative and helpful manner. The basic hazard (elapsed time) is defined as the delay plus travel plus service times for all responses to calls during a given time period in a given place. The three constructive innovations are (1) the use of predicted calls rather than calls actually experienced in the past, (2) the use of elapsed time rather than just volume of calls, and (3) an allocation simultaneously by day, shift, and district rather than by district alone. However, preventive aspects of patrol are not addressed. Also, delay, travel, and service times for all types of calls are given equal weight.

The most advanced operational method of patrol force deployment currently in use has been developed and applied in St. Louis. In their method, demand for police services is predicted by hour and geographic area. A simple mathematical technique is then used to estimate the number of patrol cars needed to immediately answer, without dispatching delay, 85 percent of the predicted incoming calls for service in each geographic area by day and four-hour time periods. The remainder of the patrol force is assigned to preventive patrol. The St. Louis efforts are a commendable beginning toward improving techniques of police patrol deployment. However, their deployment methods are limited in that the sole criterion used in the mathematical technique to determine the required number of response cars (i.e., the split of the patrol force into response and preventive units) is the fraction of calls that cannot be answered immediately by a response car. Requirements for preventive patrol are not explicitly considered when assigning cars and the question of the relative value of a car on response and on preventive assignments is not addressed. Also, certain policy issues such as the appropriate size of the mobile patrol force cannot be addressed. Based on the St. Louis method, the IBM Corporation has developed a computer program (LEMRAST) which it will lease to police departments.

The need for police services varies significantly by day of week, shift, and geographic area. Flexibility is best maintained if deployment decisions are made by time and area simultaneously. (This often gives rise to deployments significantly different from current ones.) Currently, the need for police services exhibits much greater variation, by time period and geographic area within a city, than is exhibited by the number of patrolmen actually deployed.

Dramatically different deployments can result when criteria are changed. We present several examples. In one case cited, the difference between
the current deployments to police districts in one city, and those that will result when that city implements its new deployment method, was estimated to average 30 percent over all shifts and districts. There was an estimated maximum difference of 120 percent for one shift in one district.

**Improved Methods**

No city is using all of the available mathematical tools. This does not seem to be because of a decision to avoid their use, nor because of recurring costs of using those techniques, but rather because a tested "ready to use" package is not currently available, and because the police rarely have any employees who have sufficient relevant (mathematical) training to understand, interpret, use, and communicate such techniques.

Two patrol allocation methods, mathematically feasible, but different from any now in use, possess logical advantages over those currently in use. They combine the more desirable attributes of existing methods and are sufficiently flexible to meet the needs of a variety of police jurisdictions. We suggest that such approaches be fully developed, tested, and applied.

The first approach has primary relevance to two of the three patrol issues posed, namely, patrol force strength and deployment of a specified force by time and geography. The steps in this approach are:

1. **Prediction of the incidence of crime and calls for service, by type, for each geographic area and desired time period.** These would be relevant to both decisions on current deployments and the number of additional patrolmen needed in the near future.

2. **Specification of a set of criteria and the desired target levels of performance for each such criterion.** Any set of criteria which can be analytically related to patrol manpower can be utilized.

3. **Estimation of the number of men required to achieve specified target levels of performance.** Analytic methods are available for relating number and deployment of patrolmen to measures such as average or maximum response time, percent of calls not immediately dispatchable, preventive patrol frequency, hours available for preventive patrol per suppressible crime, or probability of on-scene arrest. Unfortunately, basic knowledge is not available for relating manpower to arrests, crime, and public order. That basic knowledge deficiency is the weakest element of every available method. However, relating manpower to responsiveness and patrol coverage, as this suggested approach would, is an important step forward.
4. Allocation of patrol manpower, Quantitative techniques known as mathematical programming are available to specify the deployment of a given patrol force, by time and place, to achieve certain specified levels of service in terms of each measure. A particular overall patrol force level might not provide sufficient manpower to meet minimum acceptable service levels for all criteria. In that event, the method can be employed using various potential patrol force levels. In this way this approach also can be used to address the patrol force strength issue.

This approach, then, is more comprehensive than any of those presently in use, because it allocates on predicted demand for services, because it addresses the preventive as well as response functions of patrol, and because it employs several criteria simultaneously while striving to ensure that minimum levels of service are maintained for each criterion. One restricted version of this approach has been developed and is described in Rand Report R-593-HUD/RC.

A second method involves the simulation of patrol activities on a computer and would be useful in situations where some critical part of the patrol operation cannot be mathematically analyzed in a manner useful for policymaking. The advantage of the simulation method comes from its ability to investigate the implications of rather complicated deployment strategies and tactics, operational policies, and command-control systems by use of a computer, before undertaking expensive field tests.

For example, the simulation method can evaluate various priority and dispatching rules in responding to calls; these can range from rules on "stacking" calls and assigning cars from other areas to relocation of cars to perform preventive patrol. Also, the effectiveness of certain technological innovations, such as alternative car-locator systems, can be evaluated. A preliminary version of this approach is also described in R-593-HUD/RC.

AREAS OF NEEDED RESEARCH AND EXPERIMENTATION

There are significant knowledge gaps which make it impossible to allocate, as rationally as should be, the more than $1 billion devoted annually to police patrol programs. Because of these knowledge gaps, police administrators currently must plan largely in terms of input measures (such as number of patrolmen on the street or number of patrol hours) although what they are trying to affect are output measures of police effectiveness (such as true crime rate, apprehension rate, and speed and quality of service in response to calls for service).

In identifying these knowledge deficiencies and areas of needed research on police patrol programs, we limit our attention to resource allocation and use of police patrol forces. Our suggestions are intended to supplement, in the area of resource allocation, those of the
Police and Science and Technology Task Forces of the President's Crime Commission, as well as those of a subsequent U.S. Justice Department sponsored study of the nation's needs for research and experimentation on law enforcement and criminal justice.

We propose that research and experimentation be undertaken (1) to identify the relationship between police preventive patrol activity and crime prevention, deterrence, and on-scene criminal apprehension; (2) to identify the quantitative and qualitative relationships between speed and type of police response, on the one hand, and crime rate, deterrence of crime, probability of on-scene apprehension, availability of witnesses, and the public's satisfaction with policy patrol services, on the other hand; (3) to predict crime and the volume of calls for police services, so that police can be recruited and deployed based on more accurate knowledge of the need for police service in each geographic area and time period. Finally, we suggest (4) that improved methods for deploying patrol manpower be tested experimentally, modified if indicated by test results, and implemented.

SUMMARY OF POLICY-RELEVANT SUGGESTIONS

In attempting to provide a unified overview of certain decisionmaking aids in addressing three major police patrol issues, this study suggests that police departments:

1. Employ multiple criteria in decisionmaking. One preferred set is described in R-593-HUD/RC.

2. Develop, test, and apply improved methods in allocating patrol resources. Two such methods are described.

3. Undertake to collect certain management oriented data.

4. Hire competent, civilian planners and give them ready access to top police management.

5. Undertake long-term research and experimentation to bridge certain fundamental gaps in present knowledge regarding relationships between police resource inputs and police effectiveness.