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Optometric office design for maximizing efficiency

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Abstract

In order to design an efficient optometric examination room, we made nineteen visits to practicing optometrist's offices and a thorough review of all pertinent literature. These efforts culminated in our "optimally" efficient examination room. To test our hypothesis that our examination room was more efficient than others, a carefully controlled time and motion study was conducted. Ten timed examinations were run on a mockup of our design and ten timed examinations were run on a standard or unimproved room. All ten examiners were third or fourth year interns at the PUCO clinic. The authors served as subjects for all of the examinations. All examinations were complete-21 point procedures including biomicroscopy and non-contact tonometry. The "optimal" room design included: a set of switches on a chairside console for controlling various pieces of equipment and lights, a project-a-chart mounted above the patient's head within easy arms reach of the examiner, and a separate 14A-B light permanently pointed at the ceiling. The average examination time in the unimproved room was 59. 16 minutes as opposed to 52. 9 minutes in the more efficient room. The 6. 26 minutes, or almost 11% time savings was shown to be statistically sighificant. It is felt that any optometric practitioner could save about 11% of his examination time if he instituted these improvements into the examination room.

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OPTOMETRIC OFFICE DESIGN FOR MAXIMIZING EFFICIENCY

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ABSTRACT

In order to design an efficient optometric examination room, we made nineteen visits to practicing optometrist's offices and a thorough review of all pertinent literature. These efforts culminated in our "optimally" efficient examination room. To test our hypothesis that our examination room was more efficient than others, a carefully controlled time and motion study was conducted. Ten timed examinations were run on a mockup of our design and ten timed examinations were run on a standard or unimproved room. All ten examiners were third or fourth year interns at the PUCO clinic. The authors served as subjects for all of the examinations. All examinations were complete 21 point procedures including biomicroscopy and non-contact tonometry. The "optimal" room design included: a set of switches on a chairside console for controlling various pieces of equipment and lights, a project-a-chart mounted above the patient's head within easy arms reach of the examiner, and a separate 14A-B light permanently pointed at the ceiling.

The average examination time in the unimproved room was 59.16 minutes as opposed to 52.9 minutes in the more efficient room. The 6.26 minutes, or almost 11% time savings was shown to be statistically significant. It is felt that any optometric practitioner could save about 11% of his examination time if he instituted these improvements into the examination room.

INTRODUCTION

The form and layout of a professional office can have a great deal to do with its' success. A poorly designed office will cause inefficiency and wasted effort since design often controls function.[1] The cost of such wasted manpower in the office is always substantial when weighed with the potentials of good management and efficient design.

Our collective goal in optometry is to extend maximum manpower resources with the highest standards of practice to the greatest patient flow. This goal becomes a workable plan when supported by office facilities which are designed for the convenience of the doctor, the patient, and the office staff.

The patient invests in three basic elements: (1) the excercise of special skills and equipment; (2) the resultant goods or products; and (3) the time it takes to excercise the knowledge and provide the resultant products. As a professional office planner for Bausch and Lomb, Mercer[2] notes that this third element of time or efficiency is seldom mentioned in plan requests. Still, there seems to be a substantial need for greater concern toward efficiency in office planning. A survey of 300 professional optometrists by Chase[3] in 1971 showed that 47.9 percent of the responding doctors felt that their offices were not as efficient as they could be. Many of the reasons which were cited as causes for this problem suggested an ineffective utilization of the available office space.

This study will investigate factors which contribute to maximizing efficiency in optometric office design. Although it is not always possible to achieve the most desirable office plan due to pre-existing conditions, there are guidelines which lead to better success. These guidelines will be gathered from existing recommendations in various types of literature, a survey of optometrists and their offices, and a time and motion study. Guidelines for overall office design will be presented as well as specific recommendations for the efficient arrangement of the examination room and the corresponding instruments and equipment.

Although surveys indicate that the average optometric office consists of around 1100 square feet,[4] this is simply an average. Many offices are considerably smaller than this, but although there may be modest total area, it is surprising how efficient and effective such an office can be if a few guidelines are observed. These guidelines are equally appropriate for enhancing the efficiency of large offices.

The primary concern behind office design and planning revolves around patient services. The ease and convenience of the optometrist and staff is also important. The simplest and most effective technique in the design and planning of efficient professional offices is to outline the traffic flow of patients on an office plan drawn to scale. Then, using different colors, outline the optometrist's movements and those of the office staff. This overlay of patient and professional flow on the existing office layout depicts, at a glance, the design strengths and weaknesses. By redirecting these typical flows into more efficient combinations, facility planning assists in elevation of patient service standards.[5]

Very few optometrists have access to all the space they consider ideal; planning usually involves some compromises. The elimination of a private office or combining a consulting area with the examination room may be necessary to permit a second examination facility, a larger business office, or perhaps a specialized room. Professional functions which are under-utilized or less important may need to be allotted less space and equipment.

Barstow[6] has specified elements which should be incorporated into every office:

1) Small reception room, with a children's corner, if possible.
2) Business office which will contain the assistant's desk and necessary record cabinets.
3) Adjusting and dispensing room located adjacent to the business office. The frame bar should be in this room.
4) Case study or examination room, one portion of which should be arranged to facilitate complete darkness.
5) Laboratory.
6) Toilet.

This study will discuss guidelines for the efficient design of the reception room, business office, dispensing room, and examination room.

RECEPTION ROOM

The reception room of the office should be relatively small. The reason for this is the fact that this space does not directly earn money for you as the other primary office rooms do. Elmstrom[7] gives a rule of thumb for determining the approximate size required for this area. From your appointment book determine how many patients per hour come to your office at peak periods of a normally busy day. Add half again as many persons to account for accompanying friends a and relatives and multiply this sum by 20 square feet. This will give you a reasonably accurate indication of the amount of space normally required.

The receptionist's counter or window should be located near the door where incoming patients can be seen and greeted immediately upon entering. This permits the initial meeting between receptionist and patient to be easy and rapid. Separate greeting and dismissal windows may be useful for smoothly accomodating patient flow, especially in larger practices.

BUSINESS OFFICE

One area which is typically over-utilized is the business office, Administrative and delegated functions require adequate personnel, work stations, business machines, and filing systems. The business office must provide sufficient space for all of these components. Adequate space for the business office varies from 50 to 200 square feet, but 100 square feet is ample in most offices. It should contain a typewriter and adding machine, as well as conveniently located files.

Two working areas are preferrable to one, even for the single business assistant practice. A part-time or second aide is then easily accomodated.

The receptionist-assistant should not be isolated in the business office by a small reception window. A large window with a typewriting table or a reception counter which is about eye level height when sitting gives an open feeling while providing a definite demarcation between the office and the reception room.

The reception room and business office should be in juxtaposition for efficiency and convenience. Where possible, there should be two or more exits leading to the dispensing room, laboratory, or passage--way. The assistant's flexibility to assist, as demands require, in the dispensing room or laboratory, necessitates easy access to these areas. In addition, this aide may assist elderly patients from the sitting area into the examination room.

DISPENSING ROOM/SERVICE LAB

Brungardt[8] noted that the optometrist usually averages half his time in the dispensing room. The 1969 AOA Survey[9] showed that the typical optometrist was involved to some degree with 85% of the frame selection and 95% of the dispensing activity. Accordingly, the dispensing room and examination room should be within a few steps of each other for the convenience of both the patient and the doctor.

Hardware handling and servicing is an integral part of an optometric practice since almost 80% of the patients need a correction or change of lenses.[10] The area devoted to material selection and dispensing should, therefore be planned and designed very carefully.

Just as there are minimum seating requirements in the reception room, the dispensing area should also provide for multiple patient and staff seating. Very often two or more patients are served by an assistant at one time. As a general guideline, a soloist with two assistants in the office should provide a minimum of four patient seats and two staff stools, or two dispensing combinations. A parent, relative, or friend ofter accompanies the patient during frame selection, and the second patient chair provides for dual seating.

A separate frame bar for men, women, and children is desireable for decreasing the time required for frame selection. Mirrors should be placed on or near the frame bar and should be large enough for easy and adequate viewing.

A certain degree of privacy while selecting a frame is desired by many patients. Partitions, planters, or dispensing tables which face alternate directions may help patients feel less self-conscious and make their selection easier and more rapid.

At one time the optometrist or assistant disappeared down a long hall or into a back room to adjust or service hardware. A more efficient development is the dispensing-service laboratory complex. Using this system, the assistant remains in the room and within sight and speaking range of the patient at all times. Although the open design has the disadvantage of patients tending to visit with the assistants while they work, this is largely offset by the added efficiency of serving the maximum flow of patients in the least time with the best possible care.

For maximum patient servicing, an open dispensing-service laboratory complex can be efficiently designed in a 30 by 8 foot area.

A second small, 12 foot square, more private laboratory facilitates lens treatment procedures, evaluation, and inspection and modification of regular and contact lenses. Hardware, cases, and supplies may be stored in the private lab, and this room may also serve the optometrist and staff for informal conference-coffee break activities.[11]

EXAMINATION ROOM

The examination room can be any appropriate size or shape. Rectangular shaped examination rooms often waste floor space. L-shaped rooms or pairs of wedge-shaped rooms will save space (these rooms will require about 160 square feet as opposed to approximately 190 square feet for rectangular rooms), but they require dual corridors, which may offset substantial gains. Mauney and Porter[12] have reported that optometric findings do not seen to be affected by this shape of room. A rectangular room 22 feet by 10 feet is an efficient size for this shape, but considerably smaller rooms work out in certain situations. Mirror systems can often by used to "enlarge" an examination room.

Mercer[13] has developed the concept of a "refraction duo". In this concept, an additional examination room is utilized by the solo practitioner. This allows a quite different office routine than is possible without it. The assistant seats the patient, updates the records and positions necessary equipment before the doctor appears. Following the examination and farewells, he steps into the second room where all is in readiness for the next patient.

The examination room should be planned near the front of the office so that patients are not required to walk down long corridors to reach it. The examination equipment and patient chair is best placed near the door to the room.[14] The dispensing, business and reception rooms should be easily accessible for the efficient traffic flow of patients and staff. A key objective in the design of an efficient office, especially the examination room, is maximized patient servicing with minimal walking and movement by patient, staff and optometrist.

Wherever possible it is recommended that instruments, switches, tools and business machines be aligned carefully within easy reach. The resultant efficiency leads to less fatigue on the part of the patient, doctor and staff. Elmstrom[15] notes that the average reach of an adult man is 26.5 inches. Thus, for the male practitioner, this is the radius in which tools and writing materials in the examination room should be located for maximum efficiency.

Some optometrists utilize a consultation area before the examination to obtain comprehensive case histories and after the examination to evaluate findings and discuss care recommendations with patients. This consultation area may be a private office when space allows, but a more time and space efficient method may be a consultation desk in the examination room or in a small area just to the side.

Another intermediate station may be a small visual fields, tonometry and tangent screen room for preliminary test results and the beginning of the case history. Such stations are most efficiently placed between the reception room and examination room.

HALLWAYS

The rooms within the professional office are usually connected by hallways. These corridors should be wide enough to allow a smooth traffic flow, but should not be so wide that valuable floor space is wasted. Elmstrom[16] feels that 5 foot wide halls are not excessive and 3 foot wide halls are minimal. A two foot wide hall will allow passage for only one person, making a smooth traffic flow difficult to achieve. Also, Peterson[17] notes that hallways less than 4 feet wide will make occassional movement of equipment and furnishings difficult.

The arrangement of halls can vary from a central passageway, a single side hall, or a staggered passageway. When space allows, a double hall arrangement can be used to aid patient flow.

Just as the office layout can increase efficiency, other components of office design can increase the effectiveness of time spent providing patient care services.

Multiple telephones, located in both the business and professional rooms, can save time and steps and improve the traffic flow of staff and doctor.

An intercom system also saves time and steps.[18] The doctor and staff can communicate questions, requests and other information without leaving the room where their services are currently required. When not in use for communication purposes, soft music can be piped into every room with the addition of a radio or tape recorder. This feature helps relax patients as well as the doctor and staff, maintaining a pleasant atmosphere even on busy days. Another variation would be to have the intercom system incorporated into the multiple telephone system, assuring privacy in conversations between staff members.[19]

Alternately, a colored-light system may be used to signal when and where the doctor is needed without interruption by a loud-speaker or an assistant.

The guidelines for efficient office design which we have presented have been gathered from various articles of literature. In addition to the information presented in this literature survey, we visited 19 practicing optometrists in their offices to obtain more ideas on designing offices for efficiency. The optometrists were interviewed individually and sketches of their particular office floorplan made. The data gathered yielded many additional time-saving innovations and allowed comparison of various floorplans for evaluation of their efficiency. The accumulation of the above data led to the posing of the question, "Can efficiency be further improved?" To investigate this question, a time and motion study was devised to test efficiency principles in the examination room itself, a primary componenct of overall office efficiency. The principles obtained through this time and motion study may then be extended to other areas of an optometrist's office.

METHODS AND MATERIALS

After observing and analyzing the motions made during an optometric examination, we concluded that the examination room arrangement utilized by the average optometrist is inefficient. Several motion-saving devices and ideas were obtained by reviewing all of the pertinent literature, and through visits and conversations with practicing optometrists. All the best ideas were incorporated into our "optimal optometric room" (see FIG. 1).

To test our hypothesis that this arrangement could save the optometrist time during an examination, we conducted a carefully controlled time and motion study within guidelines from Ralph Barnes' Motion and Time Study.[20] According to Barnes, a "time study is used to determine the time required by a qualified and well trained person working at a normal pace to do a specified task".[21]

The "time standard" is the amount of time required to do the task before any changes or improvements have been made in the procedure.[22]

Our "time standard" was determined in the following way:

1) Ten examinations were run in the same room of the PUCO clinic.
2) Ten different third or fourth year interns from PUCO served as examiners.
3) The two authors served as subjects, receiving five examinations each.
4) Each examiner was supplied with a completed case history and allowed to study it before the examination started.
5) Each examination was a complete 21 point procedure including a biomicroscope examination and non-contact tonometry.
6) The biomicroscope and non-contact tonometer were in the same

room, which was next door to the examination room. This required the patient and examiner to walk approximately 45 feet in order to do these procedures.

7) All examinations were timed with a stopwatch by the author who was not being examined.

The room used to determine our "time standard" was a typical examination room in the PUCO clinic. The two arms of the instrument stand held an AO ultramatic phoropter and a B&L keratometer. The projector, a B&L free standing model, was located approximately eight feet from the patient. The room itself was 9x20 feet and had a small writing counter (20x14 inches) located on the side wall about five feet from the patient. A rheostat for controlling room illumination was located on the wall about 18 inches above the writing counter. All things considered, this arrangement was deemed to be quite efficient.

The second part of our time and motion study entailed arranging one of the PUCO clinic rooms in a way that is maximally efficient. We realize that the most efficient arrangement for one practitioner may not work well at all for someone else, but it must be remembered that our "optimally efficient" room design was the result of months of research and thought. Figure 1 is a top view illustration of our "optimally efficient" room. For purposes of our time and motion study it was not practical to include every one of the modifications found in the illustration, but all of the most important ideas were used. The following room modifications were all included in the improved room design for out time and motion study:

1) The three arms of the instrument stand held an AO ultramatic phoropter, a Mentor slit lamp, and a B&L keratometer.

2) An AO non-contact tonometer on a rolling stand was located only 3-4 feet from the instrument stand. The rolling stand was a specially constructed one that could be rolled into place as the patient remained seated in the examination chair.

3) The projector, an AO project-a-chart, was located above the patients head at a height of six feet three inches. This was within easy arms reach for all of the examiners.

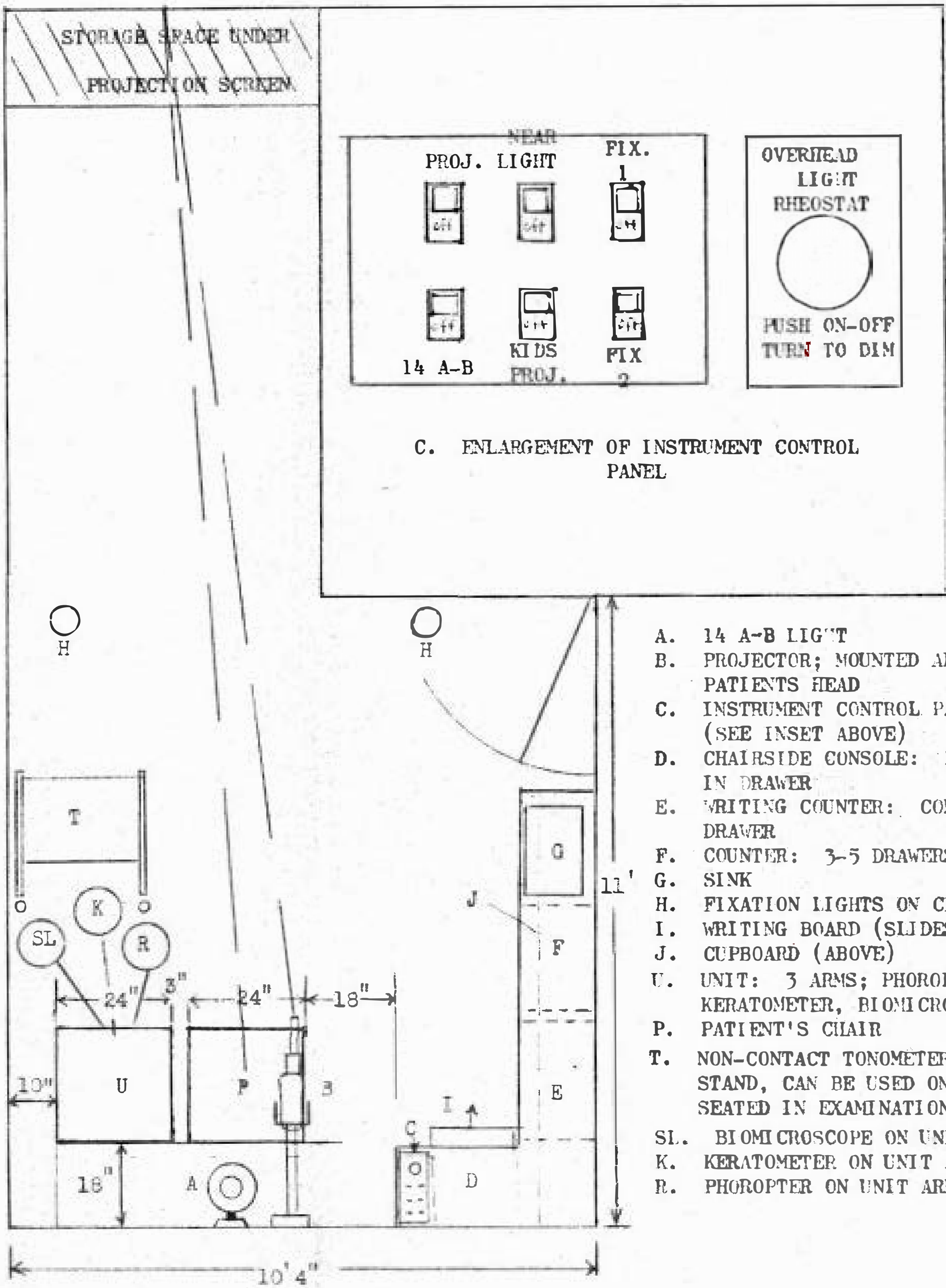
4) Two red fixation lights were mounted on the ceiling about eleven feet from the patient and one foot from each side wall.

5) A 14A-B light was mounted on the wall behind the patient about three feet from the ceiling.

6) A chairside console of 6x14x24 inch dimensions was mounted on the back wall 18 inches from the examination chair. The top of the console was 42 inches from the floor. A s can be seen in figure 1, the end of the console closest to the patient ccontained an instrument control panel with switches for the project-a-chart, near point light, 14A-B light, the two fixation lights, and a rheostat for the overhead light. The switch for the children's projector was not included because none of our subjects were children. A drawer in the console contained a lens kit and there was a breadboard type of writing board that slid out under the drawer.

The same ten interns ran examinations using the same guidelines as before. To avoid any practice effect, a different author served as the subject or this second examination. Be fore the examination each intern was given a full demonstration of all of the room modifications and allowed to familiarize himself with them. With the exception of these two conditions, all of the examinations run under these improved conditions followed the same guidelines as before.

FIG. 1. "Optimal optometric examination room", determined by a review of all pertinant literature, visits and conversations with optometric practitioners and observations of the motions made during a complete optometric examination. The hypothesis that this arrangement could save the optometrist time during an examination was tested in a carefully controled time and motion study.



A. 14 A-B LIGHT
B. PROJECTOR; MOUNTED ABOVE PATIENTS HEAD
C. INSTRUMENT CONTROL PANEL (SEE INSET ABOVE)
D. CHAIRSIDE CONSOLE: LENS KIT IN DRAWER
E. WRITING COUNTER: CONTAINS 1 DRAWER
F. COUNTER: 3-5 DRAWERS
G. SINK
H. FIXATION LIGHTS ON CEILING
I. WRITING BOARD (SLIDES OUT)
J. CUPBOARD (ABOVE)
U. UNIT: 3 ARMS; PHOROPTER, KERATOMETER, BIOMICROSCOPE
P. PATIENT'S CHAIR
T. NON-CONTACT TONOMETER ON ROLLING STAND, CAN BE USED ON PATIENT SEATED IN EXAMINATION CHAIR
SL. BIOMICROSCOPE ON UNIT ARM
K. KERATOMETER ON UNIT ARM
R. PHOROPTER ON UNIT ARM

RESULTS

There are several ways to analyze the data obtained from the timed examinations. Barnes[23] suggests using the averages of the times in the two different conditions and comparing them statistically. Generally time and motion studies of this type are compared using the t-test, which allows the validity of the results to be tested.[24] A confidence level of 95% is traditionally used in conjunction with this type of data.[25]

The data obtained from the time and motion study as well as the statistical analysis of it can be found in figure 2.

It is readily observable that the improved examination room shortened the amount of time required to perform a complete optometric examination by an average of 6.26 minutes over the standard room examination time. The average improved from 59.16 minutes to 52.9 minutes, or the examiner saved almost 11% of his total examination time. The statistical analysis shown in figure 2 indicates that the data is statistically significant at a confidence level of 95%.

FIG. 2. Time and motion study results comparing times of complete optometric examinations under "optimal" vs. "non-optimal" conditions. All examiners were interns at the PUCO clinic and were supplied with a completed case history and allowed to study it in advance. Each examination included a biomicroscopic examination and non-contact tonometry.

OPTIMAL EXAM ROOM			NON-OPTIMAL EXAM ROOM		
EXAMINER	SUBJECT	TIME (min.)	EXAMINER	SUBJECT	TIME (min.)
TC	GN	50.2	TC	JL	56.9
BP	JL	49.4	BP	GN	56.1
PL	JL	53.1	PL	GN	53.9
SM	GN	54.5	SM	JL	61.2
SS	JL	56.9	SS	GN	60.0
DE	GN	51.2	DE	JL	58.7
LN	GN	51.0	LN	JL	59.1
JG	GN	51.6	JG	JL	58.6
JK	JL	57.3	JK	GN	65.6
GG	JL	53.8	GG	GN	61.5
Mean = 52.9 min. Standard deviation = 2.58 Standard error of $\bar{X}$ = 0.86			Mean = 59.16 min. Standard deviation = 3.07 Standard error of $\bar{X}$ = 1. 02		

Standard error of mean difference = 1.78

$t = 3.52$

Degrees of freedom =18

$t_{95\%} = 2.101$

Since t is greater than $t_{95\%}$ data is statistically significant

DISCUSSION

When we began working on this project, our goal was to design an entire optometric office which was optimally efficient. We quickly learned, however, from our review of the literature and our nineteen office visits that there almost as many ideas about office design as there are optometric offices. We found that personal opinions and biases are so strong in this area that it is hard to recommend much of anything as far as the entire office is concerned. The floorplans from our nineteen office visits can be found in their original form in the appendix of copy one of our thesis at the Pacific University library in Forest Grove, Oregon.

The office visits and conversations with practicing optometrists were very important in determining which ideas to incorporate into our examination room design. We probably got more of our ideas from private practitioners than we did from the literature.

We saw more labor saving devices and ideas in the office of David H. McDonell, O.D.,[26] than we did in almost all of the other eighteen offices combined.

Dr. McDonell had a chair side console that was much more sophisticated than the one we used on our time and motion study.[27] His console was mounted on the keratometer arm of the instrument stand. The switches were all pushbutton relays which offer many advantages over the standard throw-type switches we used. The size wire needed to connect this type of system is much smaller and carries much less voltage than the standard wire we used. It is also much easier to add functions to a relay control switch than it is to a standard type of switch. On his chairside console, Dr. McDonell also had a remote control device for his automatic project-a-chart.

Since Dr. McDonell used his keratometer arm to mount his chair-side console, he had to find a place to put his keratometer. This problem was admirably overcome by incorporation his keratometer and slit lamp into one functional location. Approximately five feet from his instrument stand, he put his keratometer and slit lamp on two different stands separated by about two and one-half feet. The patient is then seated in a swiveling chair in between the two instruments where he can be rotated until he is facing the instrument that is to be used. This arrangement is especially efficient for contact lens checks since both procedures can be done without the jostling of equipment that is so often necessary with standard arrangements.

It was also Dr. McDonell who gave us the idea of a specific 14A-B light separate from the near point light. This simple concept not only saves the practitioner valuable time during each examination, but it saves much wear and tear on the near point light. The light itself is just an upturned light mounted on the wall behind the patient which is controlled by a switch on the chairside console.

Even though we thought all of these ideas were important from a labor saving standpoint, construction time and costs prevented us from duplicating all of them exactly. Room size and shape were two other factors we took into account when we were deciding where to place the equipment in our "optimal" room design. In the course of our research, we visited nineteen offices and analyzed thirty five exami-nation rooms. Two of the more consistent features we found in exami-nation rooms were the preference for full length (approximately 22 feet) examination rooms and an attempt at conserving space by utilizing either a wedge shaped or L-shaped examination room. Of the thirty five examination rooms we analyzed, approximately 61% were full length rooms and about 55% were either wedge or L-shaped. Mauney and Porter[28] reported that there is no significant difference between any of the findings taken in a wedge shaped room as compared to a rectangular room. No study could be found that compared findings taken in L-shaped rooms, but it seems unlikely from the number of L-shaped rooms currently in use that there is a significant effect. For these reasons we have included in our room design that the examination room should be either L or wedge shaped (see figure 1). The 60 square feet that one can expect to save by adopting one of these room shapes can, in our opinion, be put to much better use.

Our examination room design saved the interns an average of 6.26 minutes or almost 11% of their examination time. We feel that this 11% time savings would be fairly constant, no matter how many years of experience the examiner had. We also feel that the time savings could increase to 15-20% after the examiner had become fully familiar with the arrangement.

FOOTNOTES

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APPENDIX

The original appendix containing the floor plans in their original form are contained in copy one of this thesis at the Pacific University library in Forest Grove, Oregon.