ERGONOMICS ANALYSIS OF A HOSPITAL PHARMACY

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ABSTRACT

An ergonomics analysis of a hospital pharmacy was initiated in response to a manager's request "What is the correct height for a pharmacy bench?" following reports of neck and back discomfort by pharmacy staff. A task analysis identified the sequencing of dispensing tasks and associated ergonomics considerations using direct observation and interviews of all five staff (two technicians and three pharmacists), talk-through protocols and review of archival data (job descriptions, departmental statistics and procedural documents). A Modified Nordic Musculoskeletal Questionnaire was administered to determine the nature and extent of discomfort. A dimensional analysis measured specific anthropometric dimensions for all staff that were compared with actual workspace dimensions and recommended guidelines. A mismatch between the elbow height and bench height was identified as a factor in staff adopting stooped postures when dispensing. Deficiencies in two computer workstations were also identified as factors contributing to awkward postures. The nature, severity and frequency of discomfort and dimensional mismatches indicated that workplace redesign was a priority. Recommendations were made to improve the computer set-up and workspace layout, including bench height and stock storage. A participative approach was used throughout the implementation phase with a report providing a basis for clarifying and prioritising the design specifications. The pharmacy was completely renovated and two adjustable dispensing benches were installed. On completion staff reported favourably on a reduction of discomfort, improved workflow and space, a reduction in errors from easier tracking of prescriptions, easier cleaning and an overall more pleasant working environment. The ergonomics analysis provided an objective rationale to highlight the need for management to take action and as a result the layout and workflow of the whole pharmacy was improved.

INTRODUCTION

Reports of neck and back discomfort by four of the five pharmacy staff complaining about the bench height prompted the manager's request: "What is the correct height for a pharmacy bench?" The expectation was for an immediate numeric response so the problem could be fixed. A preliminary observation of the workspace by the Maintenance Services Manager, Health and Safety Advisor and Ergonomist indicated that changing the bench height alone would not improve the problem. As working height is a major determinant of a person's posture (Pheasant, 2001) it was important to achieve the best fit with minimal compromise by using a multi-factorial approach. To determine the issues and provide objective data, it was agreed that an ergonomics analysis was necessary. The specific purpose was to assess the compatibility between the work interfaces and the pharmacy staff and review the overall layout of the dispensary work area.

The dispensary was located within The Princess Margaret Hospital and consisted of one large room with an adjacent imprest storage room. The waiting area was separate and accessed from an external corridor. The staff room was accessed through the dispensary. There were five staff (two technicians and three pharmacists – two full-time and one part-time) dispensing inpatient prescriptions. One part-time position was vacant. It was reported that it was difficult to recruit staff because of a shortage of pharmacists and a perception that this pharmacy had poor environmental working conditions. The pharmacy staff had previously unsuccessfully submitted plans to improve the layout of the pharmacy. They had identified many design priorities, but several pages of hand-drawn plans did not provide the objective evidence to persuade managers to take any action.

METHOD

All five staff (four female and one male) were included in the analysis. The majority of the data was collected during one day on-site with several brief follow-up visits to clarify information. A task analysis was used to determine the sequencing of dispensing tasks and associated ergonomics considerations. Tasks were identified using direct observation and semi-structured interviews; talk-through protocols and review of archival data (job descriptions, departmental statistics and procedural documents). This information provided the basis for the floor plan to optimise the workflow.

A dimensional analysis included measurement of specific anthropometric dimensions of all staff (standing eye height, standing shoulder height, standing elbow height and arm grip length) using 25-mm steel tape. Actual workspace dimensions of the dispensary layout, benches, shelving, workstations and equipment were recorded and scaled plans made. The measured data was compared with recommended guidelines to identify any mismatches for reach and working heights.

A modified Nordic Musculoskeletal Questionnaire (Corlett, 1998) was administered to all staff to determine the nature and extent of discomfort.

RESULTS

Task Analysis

Staff spent most of their day within the dispensary area using the computer, standing at the dispensing bench and moving around the pharmacy to dispense up to 500 prescriptions per day. The task analysis identified five steps when dispensing medications: receiving the written prescription, prioritising, documenting the prescription and patient details, dispensing the medication and issuing the medication. Ergonomics considerations identified were: reach distance and height (when using the label printer, accessing the in-tray, accessing stock from drawers and shelves); working postures; computer set-up; walking distances and layout (location of the fax machine and photocopier; ease of movement between the dispensing bench and the stock shelves) and lighting levels for reading labels and prescriptions.

Dimensional Analysis

Either of the two computers were used when documenting a prescription. One required the operator to sit on a high stool (bench height was 990 mm above the floor with a bench depth of 570 mm). The stool had no back support and was not height adjustable. No footrest was provided. The keyboard was located in a modified drawer underneath the bench (570 mm wide and 860 mm above the floor). There was inadequate space for comfortable mouse use. The other computer had a 17–inch screen placed on the bench 990 mm above the floor. The keyboard platform was 900 mm wide by 700 mm deep and 715 mm above the floor. Both computer screens were too close for an adequate viewing distance (Occupational Safety and Health Service, 1995). Both workstations had document holders on the left side which resulted in sustained left neck rotation and side bending of the user's neck. To access the label printer 985 mm above the floor, the user had to abduct the arm to shoulder height. To reach the labels from the high stool the user had to leave their workstation. Refer Figure 1.

Figure 1: Computer workstations

Figure 2: Dispensing bench

The dispensing bench height was 895 mm above the floor. When dispensing medications, pharmacy staff adopted forward stooping postures for several minutes at a time (refer Figure 2). Most of the stock was stored on open shelving between 155 mm to 1845 mm above the floor. Less frequently used items were stored in drawers under the benches and were more difficult to access. The shelving units were positioned across the natural flow of the room and the spacing between ranged between 600 mm and 950 mm.

The measured anthropometric data for standing eye height, standing shoulder height and standing elbow height for three of the four females measured were all within the 5th to 95th percentile of the New Zealand Estimates (Wilson, Russell and Wilson, 1993). The upper shelf height was within a functional reach for the majority. The measured bench height of 895 mm was lower than the 50th percentile elbow height (1035 mm).

Discomfort Analysis

All five staff completed the modified Nordic Musculoskeletal Questionnaire were aged under 45 years and right-hand dominant. Their experience in pharmacy work ranged from 8 months to 20 years (average duration was 9.2 years). One person (who had been working the shortest time) reported no discomfort. Four reported neck discomfort and three of these reported neck and shoulder discomfort within the last seven days. The neck trouble was described as severe or very severe, brought on by activity at work, particularly associated when working at the dispensing bench. One person required

three days off work because of the discomfort. Another reported being prevented from carrying out normal activities in the past 12 months because of the discomfort. All had received treatment for the neck in the past year. Two reported upper back discomfort present daily or more than once a week and rated the discomfort as severe and very severe. One required two days off work in the past year. Four reported low back and ankle/feet discomfort. Two were prevented from carrying out normal activities because of back discomfort. Those interviewed commented about the hard floor surface contributing to their lower legs aching. The general health questions indicated that all experienced fatigue sometimes or frequently and four experienced headaches.

RECOMMENDATIONS

The combination of the nature, severity and frequency of the discomfort reported and dimensional mismatches indicated that workplace re-design was a priority. A proposed layout for the pharmacy was drawn up to improve the flow of activities and people. It was recommended that stock shelving was re-located against an internal wall away from direct sunlight and to create a more open work space with two central dispensing benches. Storage of items was recommended to be above knee level and below shoulder height to minimise the need for repetitive bending or reaching.

An “L”-shaped configuration was recommended for each computer workstation with improved access to the in-tray, label printer, phone and fax machine. The dispensing bench was confirmed to be too low. A fitting trial was proposed to establish an acceptable height of a fixed bench or the alternative was to purchase two adjustable dispensing benches.

IMPLEMENTATION AND OUTCOMES

Three meetings were held with the Pharmacy staff representatives, Facilities Manager, Maintenance Services Manager, Health and Safety Advisor and Ergonomist to discuss the report, prioritise the recommendations and consider their feasibility. Checks were made on requirements for security, fire and earthquake-proofing. An external pharmacy design consultant was asked to review the proposal and suggest any further design improvements. The pharmacy staff estimated their total stock volume to ensure that there would be adequate shelving space. The staff ranked the proposed changes by importance, so that optional features could be excluded from the final costing if necessary. Scaled diagrams of the computer desks, dispensing benches and photocopier were overlaid on the proposed plan to review layout options and determine the affect on workflow. The Maintenance Manager provided cost estimates for materials and labour and he identified how much work could be done using hospital resources. It was decided that adjustable dispensing benches could be made by adding shelving onto commercially available adjustable tables. The final design had relatively minor changes from the original concept. The Facilities Manager wrote the proposal for funding approval by the General Manager.

The alterations were completed in six weeks. Additional improvements included new lights, new vinyl flooring, air-conditioning, alarms and window tinting. Two adjustable tables were purchased and shelving attached to create adjustable dispensing benches.

Two fixed height benches for checking the completed prescriptions were positioned in parallel against the dispensing benches to improve workflow (refer Figure 3).

Figure 3: Renovated dispensary with adjustable dispensing benches

On completion the pharmacy staff gave informal feedback and were very positive about their new work area. Some subjective comments reported included “spacious”, “improved workflow”, “less walking”, “user-friendly with everything at hand”, “less carrying and lifting”, “easier checking of work”, “good vision of stock”, “easy to clean”, “lighter and brighter” and “a pleasure to come to work”.

DISCUSSION

Identifying the correct bench height was the catalyst for the review. Working height is a major determinant of a person’s posture (Pheasant, 2001). When it is too low the head and trunk are inclined forward with consequent postural stress. The reported neck and back discomfort appeared to be linked to working at the dispensing bench. The work surface height is influenced by the nature of the task, and individual preferences (Sanders and McCormick, 1993). Using an adjustable height bench allowed greater compatibility for multiple users. The nature of the dispensing work required accurate hand activity, therefore the work surface needed to be slightly above the standing elbow height reference to achieve an optimal working height.

Plans to improve the pharmacy layout had previously been unsuccessful whereas this ergonomics analysis resulted in action. The report provided a rationale for redesigning the pharmacy by describing the current situation, identifying why there were problems with the status quo and how this could be improved in a cost-effective way. Linking health and safety requirements, design standards for working heights and reach distances, patient safety issues (relating to dispensing errors), improving stock management (the potential losses from sunlight damage and inadequate stock rotation by expiry date) and staff discomfort provided a compelling “call to action”.

The ergonomist was a hospital employee therefore it was easier to informally keep up with progress. There were no direct costs involved for any of the ergonomist’s time for the project which may have under-rated the perceived value of this input to the hospital. There was no formal project brief so the scope of the ergonomist’s role was not made clear. Completion of the report was perceived by managers and staff to be the end of the ergonomist’s involvement. Managers were keen to include a specialist designer to

"check" the concept, but the pharmacists' feedback later reported that the specialist did not listen to them as users and did not add any value to the original proposal.

While the outcome was successful there were some points to note and lessons to be learnt. The Maintenance Manager reported that the lack of architectural drawings made the building work more difficult. The recommendation to purchase a sit-stand computer workstation was ignored, partly as a cost-saving measure and because the pharmacists did not fully appreciate why it was necessary. Consequently one workstation was only slightly modified rather than replaced. Visits were made to two other hospital pharmacies after the report was completed. This provided further clarification of design details and would have been more beneficial earlier in the process. A link analysis and a postural analysis using a tool such as a Rapid Entire Body Assessment (REBA) (Hignett and McAtamney, 2000) would perhaps have further enhanced the objectivity and quantification of the task analysis. Dispensing errors were not measured and this may have been another way to evaluate the effectiveness of the ergonomics interventions.

By using an ergonomics approach to assess the pharmacy as a whole rather than just focussing on the bench height, it was possible to integrate significant improvements into the final design. It was clear in this case that there was no "simple answer" to the workplace design issues. Wide consultation and participation by users are essential components of the iterative process. Managers require objective data that is easily interpreted with cost-effective, unambiguous recommendations in order to see the value of the proposed interventions. Promoting a better understanding of the ergonomist's role is an important challenge to ensure involvement throughout the whole project, particularly when deviations from the recommendations may result in unacceptable compromises.

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