THE DEVELOPMENT OF A DATA COLLECTION INSTRUMENT FOR CLOTHING AND TEXTILES INVOLVED IN CLOTHING FIRE ACCIDENTS

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ABSTRACT

THE DEVELOPMENT OF A DATA COLLECTION INSTRUMENT
FOR CLOTHING AND TEXTILES INVOLVED
IN CLOTHING FIRE ACCIDENTS

By

Elizabeth Mary Dolan

The purpose of this study was to develop a supplementary data collection instrument to obtain information about clothing and textiles involved in fire accidents. Interest in the development of the supplementary data collection instrument was generated by the publicity surrounding the establishment of the 1971 Children's Sleepwear Standard, which indicated that standards are being set with inadequate information.

Provision for setting end-use standards was made by the 1967 amendments to the Flammable Fabrics Act (FFA). The FFA was originally legislated in 1953 to eliminate the "exploding" or "torch-like" fabrics from the marketplace. The amendments in 1967 expanded the scope of the FFA to include increased numbers of clothing items and home furnishings to provide for the collection of textile, clothing, and other environmental data on fabric fires, and to establish guidelines for setting end-use standards. This first standard related to children's sleepwear was

selected as the initial end-use area somewhat arbitrarily, since the data do not indicate that a majority of accidents involve sleepwear in the zero to five age group. The need for other standards can be recognized; other end-use standards are in the process of development. However, this indicates, even more, the greater need for complete information about fabric fires because increasing numbers of these standards are being set without consideration of all factors involved in a fabric fire. The interrelatedness of the innumerable factors that contribute to fabric fires has not been explored adequately.

In an attempt to contribute to the broad data base needed for setting flammability standards, an instrument was designed to allow collection of information about clothing and textile involvement in fire accidents which is not available through the forms now used by the National Burn Information Exchange and the Food and Drug Administration. The content information needed on such a supplementary form was determined from contacts with representatives working in textiles, fire safety, government, education, and health care fields. Garment design and fabric construction characteristics, age of garment, and the care procedure used on the garment were determined to be the information needed.

To determine if the instrument did, in fact, obtain the needed clothing and textile information, the instrument

was tested at the University Hospital Burn Center, University of Michigan in Ann Arbor, Michigan and at E. W. Sparrow Hospital in Lansing, Michigan, as these were the two area burn units. In neither situation was a burn patient or caretaker available for interview; therefore, past case histories were reviewed. The data collectors relied on memory recall and hospital charts of former burn patients for the information on the fabrics involved. To evaluate instrument potential and effectiveness, face validity was determined by agreement from the representatives from the fields of health care and education; and the test-retest method was selected to demonstrate the reliability of the instrument. As six out of eleven times tested on the instrument proved reliable, the instrument can be viewed as, generally, reliable to use for obtaining clothing and textile information in fire accidents.

The development of this data collection instrument cannot be viewed as an end in itself. There is a complexity of involvement among the factors of a clothing fire which must be investigated. Thus, those who will be setting standards and other fire safety programs, will be able to use these methods effectively to reduce the seriousness of injury in the maximum number of potential cases. Standards perhaps need not be related only to garment or furnishing

end-uses, for example, standards should be considered for the most frequent sources of ignition, such as standards regulating the design of kitchen ranges.

Consumer education should also pay a major role in making the consumer aware of the accident potential of clothing in fires. Education should ideally start at the pre-school level, as this age group has a relatively high percentage of burn accidents. The traditional methods of extinguishing clothing fires may be outdated and should be re-evaluated. For instance, wrapping a burning person in a rug or blanket when those products were primarily wool (a self-extinguishing fiber) was a satisfactory method of extinguishing the fire. But today with increased use of thermoplastic, nonself-extinguishing synthetic fibers, e.g., acrylic, the severity of the injury might be increased if the same procedure was followed.

Diffusion and use of the supplementary data form developed in this study are dependent on the interest of the physicians and hospital administrators because data collection does involve additional burdens to the hospital staff. Funding, perhaps by the federal government, would help defray financial costs. A national clearinghouse for this collected data is necessary for the analysis and dissemination of the information in order to aid in the development of fire safety programs.

Elizabeth Mary Dolan

This study concentrated on clothing and textile involvement in clothing fires. However, the total picture must be viewed in order to comprehend the fabric fire situation. The supplementary data collection instrument developed in this study will offer a method of gathering data, which heretofore was incomplete or non-existent.

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By

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CHAPTER I

INTRODUCTION

The issue of flammable fabrics and clothing fire accidents is an extremely emotional one, and justifiably so. The severity of the problem cannot be measured by the actual number of deaths and serious injuries caused by these accidents, since the number is small when compared with traffic accidents. The costs can best be considered in relation to the physical and psychological pain experienced by the victim and his family, not to mention the hospital and medical fees. Only in the last thirty years has anything been done to decrease the chances of clothing fire accidents. The 1967 amendments to the Flammable Fabrics Act of 1953 provided for the adoption of specific end-use standards. (This legislation will be reviewed historically in Chapter II.)

The Children's Sleepwear Standard was the first end-use flammability standard, and problems related to its operationalization prompted this study. The standard, which became effective in July, 1972, was adopted to decrease the number of clothing fire accidents involving small children.

The purpose of this study was to develop a data collection instrument to obtain information, not currently available, on textiles and clothing involved in clothing fire accidents, in order to provide a basis for setting standards. Information about the fiber content, fabric structure, garment design, and source of ignition involved in clothing fire accidents is essential as a data base for developing standards or other fire safety programs. These types of information would allow experts to evaluate interrelationships among factors, or combinations of factors, which are the most serious contributers to serious fire accidents.

There are two forms now in use for the collection of data on clothing fire accidents. One was developed by the Food and Drug Administration (FDA) and the other by the National Burn Information Exchange (NBIE). The FDA form was constructed in accordance with the Flammable Fabrics Act amendments of 1967, to

> ". . .conduct a continuing study and investigation of deaths, injuries, and economic losses resulting from accidental burning of products, fabrics, or related materials." (FFA, 1967, p. 8)

No specific set of criteria was used in developing the form other than

> ". . .the causal relationship between host (victim), agent (product), and environment." (Jones, 1973)

The form used by the NBIE was developed primarily for the collection of information on how best to care for a burn

patient (Feller & Crane, 1970). Etiological information was also included in this form. Although information on the garment, fabric, ignition source, etc., is sought through both these forms, neither allows for elaboration on the component parts of the fabric or the garment.

The information obtained from these forms now in use concerns the fiber content of the garment worn, and the type of garment worn. Although these two variables are important, information about these alone does not reveal the whole story surrounding the clothing fire accident. Additional information is needed so that textile and clothing standards can be established to incorporate what government believes the consumer needs in fire safe clothing; what is possible for industry to accomplish; and what is the actual situation in a clothing fire.

The instrument developed in this study was designed for use as a supplement to the forms mentioned above; it was designed to allow collection of detailed information about the fiber content of the different garments involved, the garment design, fabric construction, and any care procedures which might influence the flammability of the garment.

In the past the facts surrounding clothing fire accidents have been viewed in isolation, or perhaps more accurately, in piecemeal fashion. The indication that additional end-use clothing standards for flammability will be required, suggests that all possible variables which contribute to fire accidents should be examined.

CHAPTER II

REVIEW OF LITERATURE

Chapter II is organized to provide a chronological overview of past flammability legislation, followed by a discussion of present programs and organizations associated with fire safety related to clothing.

OVERVIEW OF FIRE SAFETY PROBLEM

Fire has been man's foe as long as it has been his friend, and experience has shown that fire can destroy quickly and easily. As technology advanced and man came to control more and more of his environment, he demonstrated a less conscious realization of the power of fire to destroy (Ryan, 1969; Segall, 1969). In some ways, man is a trusting animal. The individual seems to believe that if anything disastrous is going to happen, it will happen to someone else, but not to him. Man relies on the concept that fire is his friend and will not harm him. This view may seem terribly niave, but it is unnervingly true.

The average consumer does not consciously realize that, given the proper conditions, even a steel and

concrete structure will burn. Considering how fragile an apparel textile is when compared to a steel and concrete structure, one could rightly assume that the former is inherently much more flammable. Textiles are typically porous, allowing for easy air transmission, which contributes to easy ignition and gives oxygen-support to the flame. Textiles have an extremely high surface-to-depth ratio which allows the flame to burn through quickly and spread rapidly (Nametz, 1970). Design of the clothing also influences the available oxygen supply; for example, a loose, flowing garment will ignite and spread the flame much more quickly than a close-fitting or tailored garment (Segal, 1966).

The big question facing the government and the industry is:

> How far can we reasonably go to protect people from their own carelessness, ignorance or stupidity? How can we save children who should have been better educated and better supervised by their parents? (Buck, 1971a, p. 134)

Most fires, including clothing-related ones, are started through carelessness or ignorance. Unfortunately, the victim of a clothing fire is most often a small child, an elderly person, or an invalid (FFA Amendments Hearings, 1967).

The above statements are accepted as true by almost everyone working with the fabric flammability issue. Is it possible for the government to try to protect the consumer from himself? Can lack of knowledge about fire be

dealt with through education and/or fire-safe clothing? How much can the government accomplish by concentrating on either education or fire-safe clothing? Should fire-safe clothing be mandatory for everyone? For just certain age groups? Certain occupations? Certain garments? Will the consumer accept any of these suggestions? Should education programs be aimed at the adults? Or children? Or both? Only recently has action been taken to alleviate or counteract the lack of knowledge of the consumer in the area of fire safety.

CHRONOLOGICAL REVIEW OF FLAMMABILITY LEGISLATION

Background Leading to Passage of the Flammable Fabric Act of 1953

California was the first state to have a law prohibiting the sale of dangerously flammable fabrics. This law, passed in 1945, required that all fabrics sold in California be ". . .no more flammable than cotton in its natural state." (Segall, 1969, p. 67) The definition of this law was quickly recognized as a problem. How flammable <u>is</u> cotton in its natural state? And how can something be determined as being <u>more</u> flammable than that? Even though the number of problems exceeded its usefulness, the law did point out that consumer protection was needed and some sort of regulation should be enforced (Segall, 1969).

During the late 1940's and early 1950's, there was a series of incidents involving long pile, brushed-rayon fabrics. These rayon garments primarily included boy's cowboy chaps, and men's and women's sweaters. These garments would burst into flame when exposed to so much as a cigarette ash or match spark (Maleng, 1967). Several of these incidents were recorded in Consumer Reports (February, 1952, p. 92):

> A man in California was lighting a cigarette when his sweater suddenly went up in flames. Another man was sitting in court when his burned up. . . . One was ignited by the flowing head of a match which had been blown out.

Authorities found that they could only ask manufacturers of these "highly flammable", "exploding", or "torch-like" garments if they would stop producing them. Whether or not the manufacturer complied with this request was entirely up to him. As the writer of the Consumer Reports (February, 1952, p. 92) article commented: "Safety laws are often the outcome of disasters." As the result of the publicity given to these incidents by the press, a bill was introduced in Congress to outlaw these "exploding" fabrics (Segall, 1969).

As the California lawmakers discovered in 1945, the major difficulty confronting Congress regarding the passage of flammability legislation was the definition of "highly flammable" fabrics. In order to define "highly flammable" is more specific terms than was done in the

California law, the National Retail Merchants Association, the National Bureau of Standards, and other testing organizations cooperated in developing a test method which could be used as a data base for the development of the flammability standard. "Highly flammable" was then defined as the speed of ignition and the rate of flame spread (Bennett, 1973).

Under the general requirements of the law, no apparel or fabric to be used for apparel, could be marketed if it proved to be ". . . so highly flammable as to be dangerous when worn by individuals" (FFA, 1954). The test procedures defined "highly flammable" as ". . .exhibits rapid and intense burning when tested under the conditions and in the manner prescribed in the Commercial Standard. . ." (FFA, 1954). The test procedure designated by the FFA was the 45° angle test. To pass the test and not be considered highly flammable, a plain surfaced fabric, defined as any textile fabric which does not have an intentionally raised fiber or yarn surface (FFA, 1954) should not ignite in less than 3.5 seconds, with a one-second flame impingement. A raised fiber surfaced fabric defined as any textile fabric which has an intentionally raised fiber or yarn surface, should not ignite in 4.0 seconds with a one-second flame impingement (Richardson, 1969). Most fabrics were able to pass the test measurement on the basis of a "class" test. This meant that certain fabrics with the same general construction and finishing, could be grouped into

categories and "pass" the test on the basis of one fabric in that category passing (FFA, 1954). For instance, ". . .a plain surface fabric (without raised nap or pile) that weighed two ounces or more per square yard could pass the test hands down." (Business Week, 1954, p. 108). The class of fabric weighing two ounces or more included most of the fabrics which were used for apparel at that time, and today too.

The Act passed in 1953 was thus limited in its scope. The intention of the men who drafted the law was to eliminate the "exploding" fabrics, such as the "torch" sweaters. The law did not eliminate commonly used, and readily flammable, fabrics such as the cottons and cotton blends, nor most rayons or acetates. Many untreated fabrics made from cellulose or regenerated cellulose are quite flammable under normal wearing conditions. These fabrics were not the exploding or dangerously flammable fabrics which the law was meant to control, and they could pass the 45° angle test for flammability, or were passed as a matter of class test. Yet, had the test procedure been made so stingent that it classified these "everyday" fabrics as dangerously flammable, most apparel fabrics used in the early 1950's would have been eliminated from the market.

The enforcement of the Act was delegated to the Federal Trade Commission (FTC). The FTC was authorized to make any rules and regulations necessary for the proper

enforcement of the Act. The FTC was also to inspect and test any fabric or apparel article which might violate the law (FFA, 1954). When the law went into effect the FTC was thought to be a rather weak enforcement agency. As was stated in a Business Week (1954, p. 109) article:

> Since the FTC has hardly any enforcement staff, what's involved here is pretty much a system of self-enforment. The voluntary system of guarantees handed down through the industry to the consumer has to work, or enforcement, at best, will be a hit-and-miss affair.

Soon after the passage of the Flammable Fabrics Act in 1954, Macy's offered a fire-retardant baseball suit. Macy's promoted flame retardancy for children's costumes and uniforms, since these had been suspected as a possible fire hazard. However, even an intensive advertising campaign did not stimulate the consumer to purchase (Baker, 1972). Thus, what proved nonprofitable in the free enterprise economy was eliminated from the market. Between the years that the Act went into effect, 1954, and about 1966, flame-retardant fabrics were not promoted by retailers and were not produced by manufacturers in any significant numbers because of the lack of consumer acceptance. Yet, only a few fabrics and apparel items were designated "highly flammable" according to existing legislation and consequently few were removed from the marketplace by the FTC.

FLAMMABLE FABRICS ACT AMENDMENTS OF 1967

As time went on, dissatisfaction with the Act grew. Although consumer groups and Congressmen realized that the Act had eliminated the most dangerously flammable fabrics from the marketplace, the actual percentage of deaths and injuries resulting from clothing fires had not decreased as expected. There was a growing feeling that the scope and regulations of the Flammable Fabrics Act should be reviewed and amended to decrease the number of fatal and serious burn accidents (Maleng, 1967).

At the 1967 meeting of the American Retail Federation, Frederick Dent, of Mayfair Mills, stated that:

> . . .Almost 70% of total mill consumption in 1966 consisted of cotton and rayon, and that another 24.6% consisted of man-made fibers, largely nylon and polyesters. 'All of these fabrics representing the major part of the total production of the textile industry will burn readily if ignited. . . . The relevant question is not whether fabrics burns, but the extent to which this fact presents an unreasonable risk to the public.' (American Dyestuff Reporter, 1967, p. 37)

The problem facing the legislators when they tried to amend the FFA was: which fabrics present an unreasonable risk to the public? The majority of fabrics used in apparel were made from fibers which burned readily, and these fabrics were not touched by the FFA in its original form.

President Kennedy's message to Congress on the Rights of the Consumer--the right to safety, the right to be informed, the right to choose, the right to be heard--

served to increase the concern of certain groups for the plight of the unwary consumer.

> The consumer has a right to be protected not only from explosive fabrics, but also from those which burn at an unreasonably rapid rate. As technology advances it is mandatory that a mechanism be provided by which technical standards of flammability can be improved and upgraded. (Maleng, 1967, p. 52)

Acting Secretary of Commerce Alexander B. Throwbridge made these remarks at the 1967 meeting of the American Retail Federation:

> Concern for consumer protection is a reasonable activity for the government and will continue. Business benefits no less than the buyer from measures that ensure fair play in the marketplace and strengthen consumer confidence. (American Dyestuff Reporter, 1967, p. 37)

The concern for consumer safety spearheaded the movement to amend the Flammable Fabrics Act in 1967. The purpose of the amendments, as stated by Senator Warren G. Magnuson was: "to transform the limited terms of the Flammable Fabrics Act into a comprehensive fire safety law for all household and personal fabrics." (Maleng, 1967, p. 51). The amendments gave the Department of Commerce authority to develop and revise standards of flammability for fabrics or products. The Department of Health, Education and Welfare was authorized to make a comprehensive study of the deaths, injuries, and economic losses caused by the burning of fabrics. The law was extended to cover interior furnishings. The Secretary of Commerce was

charged with instigating research into new testing methods for flammability (FFA, 1967).

At that time, there was no central agency or clearing house to collect and tabulate data on the injuries and deaths due to clothing fires. Everyone concerned in the area of fire safety admitted that one stumbling block in the attempt to develop standards was the lack of reliable and complete statistics about the clothing and textiles involved in clothing fire accidents (Maleng, 1967; Segall, 1969). The 1967 amendments provided for the establishment of an agency for this research. As was pointed out in the opening statements of the hearings of the Flammable Fabrics Act amendments:

> Significant generalized improvements in the present standards can be accomplished only after there is intensive research into the feasibility of reducing the flammability of various materials. While methods for reducing flammability exist today, better and less expensive ones need to be found. (FFA Amendments Hearings, 1967, p. 8)

Results Following 1967 Amendments

Within the industry, the new amendments were regarded as a challenge to scientific research abilities. There was also a very positive attitude toward establishing increased flammability research in the areas of topical finishes and in fiber modifications (Textile Industries, 1968). The textile industry accepted the amendments as consistent with other recent legislation concerning consumer safety.

> One of the reasons for the Amendments to the Flammable Fabrics Act and many other pieces of legislation that are now before the Congress or have been before it in recent years, is a philosophy that trying to educate people to behave safely is not enough. (Ryan, 1969, p. 69)

Government decision-makers perceived increasing pressure from consumer groups to reduce the number of clothing fire accidents through increased legislation requiring more stringent flammability standards. Government policy makers supported the passage of such standards which, in essence, would protect the consumer from himself. Yet there was still a note of apprehension as to whether or not the consumer would accept the flame-retardant products if other alternatives were available.

The apprehension was not unfounded; the earlier experience with Macy's marketing flame-retardant costumes had proved unsatisfactory, as well as several additional manufacturers later attempting to voluntarily market flame-retardant garments, which consumers did not purchase. These flame-retardant garments offered increased protection for the consumer beyond the Flammable Fabrics Act regulations (Baker, 1972).

Manufacturers and retailers, in addition to the legislators, were receiving increasing pressure from consumer groups to offer flame-retardant garments on the market. In the mid-1960's, the J. C. Penney Company introduced ladies' fire-retardant housecoats, which did not sell. Penney's ended up mixing these fire-retardant

housecoats in with less expensive untreated housecoats at the lower price in order to sell them (Baker, 1972). More recently, Sears introduced flame-retardant children's pajamas, first in the catalogue then in the stores, accompanied with extensive advertising campaigns. Sears sold 25 percent of the number that had been anticipated (Feltman, 1972). These examples represent the efforts on the part of the industry to market flame-retardant clothing voluntarily after the passage of the FFA, in order to prevent legislated standards. However, the consumer was still not interested in buying these more expensive products. Yet, the problem of fire safety was not solved to the satisfaction of burn victims and consumer advocates, so the government deemed that end-use flammability standards were necessary whether the consumer wanted the flame retardant clothing or not.

The lack of factual data on which to base the standards was the issue which prompted this study and which continues to face the textile industry and government policymakers. As William Segall, of the Office of Textiles in the Department of Commerce, stated:

> If we look at the tests that are currently available to textile technologists and compare them with the kinds of information we must have in order to determine the hazard of fabrics for any particular end use, we see that there are some serious gaps in our ability to provide all the information that may be needed. (Segall, 1969, p. 69)

The more recent testing methods developed for the Children's Sleepwear Standards are still not accurate simulations of what would happen in real life; there remains a lack of factual data on what actually happens in a clothing fire accident. Industry representatives consider it difficult, if not next to impossible, to prepare end-use standards without first developing adequate test methods (Weinstein, 1971; Howry, 1972). To date the test methods only get at ease of ignition and rate of flame propagation, no doubt because these two characteristics are the easiest to test. These test methods successfully eliminated the "exploding" types of fabrics as was the intent of the Flammable Fabrics Act of 1953. With the 1967 amendments, the needs of the testing procedure changed. R. D. Bennett of the Department of Consumer and Corporate Affairs, Ottawa, Canada, states the problem this way:

> One of the most difficult tasks to be faced in developing and using adequate flammability test methods is in determining the actual hazard involved and in relating the test method to the hazard. . . . (Seven factors) emerge most frequently as being the most important to the subject in hand. These are ease of ignition, rate of flame propagation, generation of smoke and noxious gases, total heat emission, flame temperature, thermoplastic behaviour of the material and ease of extinction of the flame. (Bennett, 1973, p. 66)

The opposition within the textile industry to the amendments and to the passage of the standards was in reaction to the fear that the standards would be ill-conceived; that is unfair to the consumer and to the industry. There was

also fear that the testing procedures would be unworkable (Segal, 1966). In a presentation to Inter-Industry Technical Committee program in 1972, Fred Fortess verbalized the textile industry's position in this manner:

> The major problem confronting the fiber, textile and end-product industries is the concern that the standards are unrealistically strigent seeming to aim at elimination of hazard rather than a significant reduction and that the test methods do not relate to known conditions of ignition and are too non-reproducible to permit confidence in manufacturing without very high cost of testing. (Fortess, 1972, p. 2)

The 1967 Amendments of the Flammable Fabrics Act authorized the Department of Commerce to use the data collected by the Department of Health, Education, and Welfare on deaths, injuries, and economic losses from the accidental burning of textile products, to suggest end-use flammability standards, which were to take the form of a Federal Trade Commission Ruling (FFA, 1967). Based on the investigations by the Department of Health, Education, and Welfare the first end-use standard passed was the Children's Sleepwear Standard.

The Children's Sleepwear Standard

Children's sleepwear was selected as the first end-use standard since 23.2 percent of the 713 garments collected by the National Bureau of Standards involved sleepwear. The standard was focused on children's garments because of the higher accident rate in the 0 to five years group than

any other age group except the 66+ years group (Tovey, 1971).

At the fourth annual meeting of the Information Council on Fabric Flammability, Dr. J. E. Clark, Chief of the Office of Flammable Fabrics, stated that the decision for the children's sleepwear standards was:

> . . .based on investigations of case histories and laboratory research on fabric samples recovered from fires, tests on children's sleepwear garments purchased in the open market, and simulation tests on mannequins in garment burn studies. . . . While many fabrics for this end-use meet accepted criteria, the final garment does not and responsibility for testing and compliance was extended to the manufacturer. (Clark, 1971, pp. 4-5)

The textile industry viewed the proposed standard with skepticism.

> The impact of the total textile industry, in which flame resistance will be superimposed on fashion, style, aesthetics, price, and the regular functional properties for children's sleepwear items, were claimed to be unachievable without drastic changes in textile technology and apparel production. (Fortess, 1971, p. 10)

At the time the standard was proposed, George Buck (1971b) of Ramcon, and Fred Fortess, of Celanese, felt that there was not significant data to warrant the strict standard. Fortess stated:

> . . .Congress must provide money to fund the surveillance staffs and obtain the field data if they want the job done right. . . . In general we exchange one problem for another by establishing a precise standard with unrealistic testing, without knowing the fire circumstances under which children's clothing becomes ignited. (Fortess, 1971, p. 11)

Despite industry opposition, the Children's Sleepwear Standard was adopted in July, 1971, and included nightgowns, pajamas, slippers, etc., from size 0 to 6X. To give the industry time to develop fabrics which met the standard, a year's grace was allowed. From July, 1972 to July, 1973, the designated sleepwear which did not pass the testing procedures were to be labeled as "flammable." As of July 29, 1973, the standard requires that all sleepwear, from size 0 to 6X, must pass the testing procedures outlined in the standard.

The standard requires that the entire garment and all the findings and trim be tested for flammability, not simply the fabric. The test procedure is as follows:

> The garment is laundered 50 times and dried bone dry. A swatch of the garment is then suspended in a vertical holder in a prescribed cabinet and subjected to a standard flame along the bottom edge for three seconds under controlled conditions. The char length and residual flame time are measured. (Char length is the distance charred from the original lower edge of the specimen exposed to the flame. Residual flame time is defined as the time from removal of the burner from the specimen to the final extinction of molten material or other fragments flaming on the base of the cabinet.)
>
> An item meets the standard if the average char length of five specimens does not exceed 7 inches; if an individual specimen has a char length less than 10 inches; and if an individual specimen has a residual flame no greater than 10 seconds. (Chemical and Engineering News, 1972, p. 22)

Industry spokesmen claim that this test is too complex, to stingent, and non-reproduceable (Chemical and Engineering News, 1972; Buck, 1972; Fortess, 1972). Those who voice

objection to the current testing method, have suggested that a more realistic and a more simple method must be developed and adopted. The method most often suggested involves an accelerated laundering procedure which would be similar to 50 launderings, and the use of a mannequin for the flame testing. This method, especially the use of the mannequin, would more closely simulate what happens in real life. And it would also reduce the testing burden of the garment manufacturers (Chemical and Engineering News, 1972).

Consumer advocates assume that all people want to be safe from the perils of clothing fires, which is probably true. Yet, few consumers plan to be careless with fire, and fewer still think they will ever be burned (Feltman, 1972). This writer was unable to locate any opinion polls taken of the consumer's attitude on the subject of flame-retardant garments. Therefore, in-depth interviews were conducted with 10 consumers in the Lansing area to determine consumer reaction to flame-retardant sleepwear (Dolan, 1973).* The results indicated:

1. Consumers realize that fire safety is important.
2. Consumers are annoyed at paying $2.00 more for flame-retardant sleepwear.
3. Consumers are hesitant to buy sleepwear labeled "flammable".
4. Consumers do not like having the flame-retardant sleepwear forced on them.

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*Research done for Advertising 823, Consumer Behavior, taken at Michigan State University, Spring Term, 1973.

5. Consumers think that flame-retardant sleepwear should be available but that this type of protection is not always needed, e.g., when there is no fireplace or parents do not smoke.
6. Play clothes would be the more logical end-use standard for flame-retardant finishes.

There were no figures available at this writing as to how well flame-retardant sleepwear was selling in retail stores compared to the untreated sleepwear, allowed on the market under a "flammable" label until July, 1973. If such data were available, the figures would perhaps show the treated sleepwear selling quite well, based upon findings from the Dolan interviews. The consumer does not like to see "flammable" on the garment she is buying for her child. Additional factors which the Dolan interviews found to influence the consumer's attitude against the treated sleepwear were: decreased durability of the fabric; stiff hand or the fabric; and the current styling of pajamas and nightgowns to be more close fitting (Dolan, 1973).

Flame-retardant sleepwear which meets the standard has been on the market for about a year now. Has anything been learned from this experience which government can use in setting of additional new standards? Michael James, of the Institute for Burn Medicine, thought not (James, 1973). Those who are preparing the new standards have ignored the negative consumer reaction.

James also postulated that perhaps children's sleepwear was designated as the first end-use standard, since

the children's sleepwear industry is relatively small. He made this comment in light of statistics from the NBIE which show only 13 percent of all clothing fires studied by the NBIE involved children five years or younger, in their sleepwear.

Summary

Much progress has been made in realizing the complexities of problems involved in fabric fires since 1945, and the first, vague flammable fabrics law passed by the California legislature. The elimination of the "exploding" fabrics from the market was the first step toward consumer safety. The 1967 amendments to the Flammable Fabrics Act was the second step, and now end-use standards are a further step. By expanding the scope of the Act to include additional apparel and interior furnishing items, and by calling for end-use standards, the policy-makers in the area of fabric flammability are coming to realize the necessity of extensive research on the complexities of the variables involved in clothing fires.

RESEARCH-ORIENTED ORGANIZATIONS

To present an organized chronological review of the flammability legislation above, a discussion of the fabric flammability organizations was placed in the following separate section. The National Burn Information Exchange (NBIE) was organized in 1964, and the Information Council

on Fabric Flammability was organized in 1967. Their research power has only recently come into prominance in the field of fabric flammability. Project SAFE was organized in response to the adverse publicity given the apparel industry over the Children's Sleepwear Standard.

The National Burn Information Exchange

The idea for the National Burn Information Exchange (NBIE) was conceived by Dr. Irving Feller of the University of Michigan University Hospital, in 1958. He had observed that there was an extremely high mortality rate with burn injuries. At that time, death from a burn injury was normally recorded as "Burns" (Feller and Crane, 1970).

> Very little attention was being paid to the burn injury as a complex medical problem. . . .(And) there were only a handful of physicians. . .who recognized and responded to the magnitude of the burn problem. (Feller & Crane, 1970, p. 1425)

The University of Michigan University Hospital researchers began gathering data from past burn patients' records, on the extent of burn injury, treatment, and etiology. The researchers found that the data was often incomplete and very scanty.

In 1964, The National Burn Information Exchange was officially formed when two other medical centers joined the University of Michigan research effort. The purpose of the NBIE was stated as a method of providing a consistent and comprehensive system of collecting data on burn victims. The objectives of the organization are stated as follows:

1. To establish "standards of burned patient care" by citing specific results that can be achieved under optimum conditions.
2. To provide etiology information for the prevention of severe burns.
3. To provide information for the improvement of the burned patient's care, by reporting those specific techniques and principles that have proved valuable in the Burn Centers, Units, and Programs.
4. To further develop the expertise of the NBIE membership by comparing methods and results in larger numbers of cases. (Feller and Crane, 1970, p. 1427)

The NBIE was founded primarily to deal with the care of burn patients. However, the prevention of clothing fire accidents is viewed as a part of preventive medicine. The NBIE was originally funded by the FDA to aid in the collection of etiological information on clothing fire accidents. Due to the scope of the program in the NBIE (now 22 hospitals and medical centers are members) increased amounts of information and clothing samples could be collected for the National Bureau of Standards (NBS) to analyze. All etiological information for each burn patient, received at one of the NBIE member burn units, was sent to the NBS for further analysis and to be added to the bank of information kept on fabric fires. This bank of data was used in determining the first end-use standards for flammability, the children's sleepwear. The funding of the NBIE was terminated in 1972 because of a cut-back in appropriations to the FDA for research. Since the NBIE is no longer funded by the Food and Drug Administration, the members do not receive financial support for data collection and therefore are not "going out of their way"

to collect clothing samples from the burn patients. However, if any samples are obtained, they are sent to the National Bureau of Standards for analysis (James, 1973).

The NBIE still keeps detailed records of etiology of each burn patient, in keeping with the organizations objectives. This organization has proved in the past to be a valuable data collection tool. Dr. Irving Feller is vitally interested in the involvement of clothing in burn accidents, and under his direction, the NBIE will undoubtedly remain in the forefront of the campaign for fire safe clothing.

Information Council on Fabric Flammability

The Information Council on Fabric Flammability (ICFF) grew out of a conference held in 1966 which was sponsored by a number of diverse organizations, all interested in the problem of the fabric fire.

> "The Council, a multidisciplinary organization, works for the reduction of morbidity and mortality from burns caused by flammable fabrics by encouraging the exchange and dissemination of relevant information." (American Dyestuff Reporter, 1973, p. 54)

Observers at the last Council meeting, December, 1972, noted that after five years of focusing on separate parts of the fabric fire problem, members were beginning to look for ". . .the underlying causes of clothing burns" (Suchecke, 1973). The value of the Council lies in the teamwork approach, The members of the Council have begun

to work together and to keep each other informed on the research progress which is being made in the various areas (Suchecki, 1973).

Project SAFE

Project SAFE (Safe Apparel for Everyone) is the American Apparel Manufacturers Association (AAMA) response to the flammability issue. The members of the AAMA have accepted the fact that fire-retardant finishes are, in the future, going to possibly join the ranks of the general mill finishes. Now flame-retardant finishes are under development which do not cause adverse aesthetic and durability affects to the fabric, and soon flame-retardant fibers will be available. "We predict that in the near future most of the garments we manufacture will be flame retardant" (AAMA, 1972). Project SAFE, along with giving direction and coordination to the industry's efforts to develop flame-retardant garments, is in a sense, a public relations organization.

> When the industry had pointed to short-comings in some "cures" for flammability (just after the adoption of the Children's Sleepwear Standard), critics hinted at ulterior motives. Thus, in a sense of urgency, AAMA's Apparel Products Flammability Committee. . .got the project off the drawing board. . ." (TIPS, 1973, p. 4)

A committee comprised of textile and clothing experts, mainly college professors and extension specialists, is working with the Textile Trade Association, American Textile Manufacturers Association, and the American Apparel

Manufacturers Association on an educational booklet on flammability. This committee will also be monitoring the TIPS publication and commenting on articles appearing in it (American Home Economics Association, 1973).

The new Consumer Products Safety Commission incorporated what used to be the Bureau of Product Safety. This new agency, formed by law in 1972, is an independent regulatory commission for all consumer products. It acts as a clearing-house for consumer injury information through the collection, investigation, analysis and dissemination of injury data. The Commission is authorized to investigate and develop new testing methods for any consumer product and to develop safety standards (Sub-Council of Product Safety, 1973). The Commission has potential to act as the organizing and unifying clearinghouse for fabric fire information. Much depends on the funding the Commission will receive in the future, to reach this objective.

Summary

The multidisciplinary organizations just reviewed, and others like them, are probably the "hope" for the future in the area of fabric flammability. The foresight of the people in these organizations to view the fabric flammability problem as a complex whole, rather than in piecemeal fashion, will lead to a greater understanding of what the real situation is in a clothing fire accident.

The inevitability of new end-use flammability standards emphasizes the need for this understanding.

CONCLUSIONS

The historical background just reviewed indicates factors which led to the passage of flammability legislation and standards. Since the first flammability legislation in 1945, government has taken an increased responsibility in the interest of consumer safety. In response to the consumer movement people from the areas of medicine, textiles, fire safety, education, law, etc., have banded together to offer direction to the efforts of the government. Several organizations have emerged which may contribute to the increased understanding of the complexity of the clothing fire.

One item appears in the literature throughout the history of flammability legislation--that there is simply not enough known about the complex interrelationship among the variables in a fabric fire. The review of the literature, therefore, supports the purpose of this study.

CHAPTER III

METHODOLOGY

Chapter III is organized into three parts; first, an overview is presented of the research problem, which was to design a data collection instrument to obtain information about textiles and clothing involved in clothing fire accidents. Second, a discussion follows on how information was collected to determine type of instrument needed for data collection about clothing and textiles involved in fires. Third, the procedures used for instrument development are included.

OVERVIEW OF RESEARCH PROBLEM

The data collection instrument was designed to supplement the forms now in use--the form used by the National Burn Information Exchange (NBIE) and the form used by the Food and Drug Administration (FDA). In order to develop a supplementary data collection instrument about clothing and textiles involved in fires, the following information was needed:

1. The textile and clothing content information deemed essential by individuals working with the fabric flammability problem.
2. The essential clothing and textile content information not now collected with the two forms currently in use.

3. The method of collection which would be most efficient for the variety of data collectors using the instrument.

The above information was obtained through correspondence, interviews and interview schedules with various people concerned with the problem of fabric flammability. Based on the information gained from these sources, a supplementary data collection instrument was designed to obtain the missing information about clothing and textiles involved in clothing fires.

BASIS FOR DESIGN OF DATA COLLECTION INSTRUMENT

The collection of background information necessary to design the instrument is discussed in this section. Results of the contacts with textile industry, fire safety, government, and health care representatives follow.

Textile Industry Representatives

Laura Baker Buchbinder, research associate for the Cotton Foundation in the National Bureau of Standards (NBS) (formerly a Textile and Clothing faculty member at Ohio State University), provided input on the type of information needed to set textile standards for increased fire safety. Buchbinder said she is beginning to feel the fiber content of the garment may not be the deciding factor in a clothing fire. The need for the description of the design of the garment, the involvement of trim and multiple layers was emphasized by her. She reasoned that knowledge

of the fiber content and even a sample of the fabric cannot begin to point out the complexities of clothing fires. Further, she commented that the knowledge of a nontechnical person in collecting clothing and textile information determines the quality of the information obtained.

> The amount of . . . information which could be gathered by a non-technical person would depend largely on the clarity and detail of the instrument developed and the willingness of the people involved to use it. (Buchbinder, 1973)

In Buchbinder's opinion, hospital personnel should only:

> . . .be expected to collect samples of clothing or gather information from labels, indicate whether or not there was melting or hardening of the fabric and perhaps give a general idea of the relative weight of the fabric. . .(as) the average person cannot correctly identify the fiber content or fabric construction of a garment. (Buchbinder, 1973)

Fred Fortess, formerly of Celanese Fibers Marketing Company, now chairman of the Department of Textiles at Philadelphia College of Textiles and Science, has been very active in the study of fabric flammability. He emphasized the need for knowledge of the nature of the fibers, fabrics, and garments most often involved in fire accidents. Fortess also recommended improving data collection techniques of the existing data collection forms (Fortess, 1973).

Fire Safety Representative

Louis Segal, Fire Prevention Engineer in the California State Fire Marshals Office, was contacted as a

representative in the area of fire safety. Segal is a leader in the field of fire safety and is very concerned about the role played by fabric in fire accidents. He described the ideal data collection procedure as including a thorough questioning of the victim or the caretaker,* plus retrieving all possible remains of the garments in the fire accident. He also mentioned the necessity of knowing how long each garment had been in use and how many times each had been laundered, since these factors contribute to potential flammability of garments. The type of garment, the construction and weight of the fabric and the fiber content were also mentioned by Segal as very important elements in a clothing fire (Segal, 1973).

Government Representatives

James A. Jones, from the Bureau of Product Safety (which has recently been incorporated into the Consumer Products Safety Commission) commented on the purposes of the form used by the Food and Drug Administration (FDA).

1. To provide the Department of Commerce with data needed to determine whether a standard is required for a specific fabric product;
2. To provide the DOC with sufficient information surrounding the accident situation to aid in developing such standards;
3. To provide the National Bureau of Standard with the information necessary to develop test methods;
4. And to furnish DHEW with sufficient etiological factors in order to properly analyze the

*The caretaker is defined as the parent, relative, guardian, or friend who has the greatest knowledge of the incidents surrounding the accident.

> circumstances surrounding the accidents which would aid in developing preventive or remedial measures. (Jones, 1973)

Jones also commented that the answers relating to textiles and clothing involvement were entirely dependent on the expertise of the individual investigator. Hospital and physician cooperation with the FDA ranged from excellent to poor. The amount of cooperation is dependent upon the degree of interest in the problem of clothing and fabric fires (Jones, 1973).

John Krafny of the National Bureau of Standards (NBS) offered insights into the use of the form used by the FDA. The FDA originally sent its own investigators to collect the information of clothing and fabric fires. These investigators were trained to collect information from the hospitals when a burn victim was admitted. The data was collected through an interview with either the burn patient, a relative, or friend of the patient. The investigator tried to obtain samples of all the fabrics involved in the fire accident.

The form is now administered on a contract basis. Agencies in the areas of the hospitals associated with the FDA's effort, are contracted to hire investigators to collect the burn patient information. Krafny commented that the contract data collectors had not proved knowledgable in the area of textiles. As a result, the quality of information coming in through this form has decreased. The missing information not obtained with this

form, according to Krafny, concerns the fit of the garment, and whether the garment or fabric is more than one layer. A complete description of the fabrics involved is not always obtainable nor are the garment styles involved is the fire adequately described. For example, a slip worn underneath a dress may have caused injury, but the only information or fabric samples received at the NBS might concern the dress. In such cases, no other information is available on the slip, other than it was worn at the time of the accident (Krafny, 1973).

The above correspondence points to the content information and the format of the data collection instrument--what information should be collected at what levels of expertise?

Health Care Representatives

Michael James, Administrator of the Institute for Burn Medicine in Ann Arbor, Michigan (the Institute is the administrative organization for the NBIE) indicated that a large portion of the samples and case histories used by the NBS have come from the University of Michigan University Hospital and St. Joseph Mercy Hospital Burn Units in Ann Arbor. Since one person is designated to collect all information on burn patients at Ann Arbor, the etiological information obtained from the two Ann Arbor Hospitals is more complete than at other hospitals, or than that which is collected by the FDA investigators (James, 1973).

Interviews with Hospital Administrators

The policy-making administrators of three Lansing area hospitals were contacted in order to determine the potential interest and the amount of cooperation which might be expected from local hospitals. The variations among these three hospitals suggested a variety of data collection procedures operating. The administrators were asked such questions as:

> What are admitting procedures?
> When is the medical information collected?
> By what method is it collected?
> Would you be willing for this hospital to cooperate in collecting nonmedical information on burn patients?
> (See Appendix A for interview schedule.)

The results of these initial interviews are summarized as follows:

A. In the Lansing area, hospitals without Burn Units average about 12 burn patients per year.

B. The hospitals have their own data collection forms for medical information.

C. Information is obtained on accident victims after treatment, from either the patient or the caretaker.

D. Information is collected by a variety of persons, from the attending physician to the admitting clerk in the emergency room. The collection of this information may or may not be the specific responsibility of that person.

E. Hospital administrators believe:

   1. The responsibility for collecting non-medical data on burn patients varies; three opinions were:
      a. the individual hospital with a national clearinghouse;
      b. a national organization;

c. the individual physician or group of physicians.

2. Cooperation from other hospitals might be obtained through assuring hospitals of an organized method of data collection, and by getting the physicians interested.

3. Hospitals might be encouraged to collect data by showing significant results with the data, and perhaps funding the hospital to do this.

F. The willingness to cooperate in the collection of nonmedical information on burn patients ranged from "very interested" to "not willing at all".

Hospital procedures which need to be kept in mind when developing the data collection instrument were determined. Implications from these interviews suggested procedures for dissemination of the data collection instrument. The implications for dissemination are discussed in Chapter V.

Interviews with Potential Data Collectors

The potential data collectors interviewed were identified by the hospital administrators. A variety of potential data collectors emerged due to different hospital organization and admission procedures. Data collectors from two of the hospitals were interviewed. At the third hospital, the medical information was collected by the physicians, and they were not available for interviewing.

In order to collect the most accurate clothing and textile information, the ideal would be to use textile experts as the data collectors. Hospital administrators feel, however, that this ideal is unrealistic in terms of financial support. Data collectors, therefore, are likely

to be nurses or physicians who collect the medical information on burn patients.

The potential data collectors from the two Lansing area hospitals were asked questions concerning their relationship with the burn patient; their knowledge of the flammability issue and attitude toward it; and in general, their knowledge of textile terms (See Appendix B for interview schedule). The results of the interviews are summarized as follows:

A. Data collectors tended to be female.

B. Data collectors had limited knowledge about textiles.

   1. They could not define "fiber content" but could give examples. However, they did know that garment hang tags include fiber content information.
   2. They defined fabric construction generally as how the fabric was made. They found it easier, again, to give examples.

C. They were not familiar with current standards of flammability, e.g., Children's Sleepwear Standard.

D. They offered these other possibilities for reducing the number of clothing fires:
   1. Parent education.
   2. All nonflammable clothing.
   3. Mass media usage to inform public.
   4. Close fitting clothing styles.

E. They suggested these means of successfully getting the clothing and textile information from the patient or caretaker:

   1. Collect information after patient is treated and probable outcome is known to the caretaker.
   2. Give respondent rationale for needing the information.

3. Suggest fabric names and fiber contents to respondent.

Implications from these interviews suggested that a checklist or similar format, which included listing possible answers to questions, would give a nontechnical data collector a better chance of obtaining information.

Conclusions from Information Obtained

The background information obtained from representatives of the textile industry, fire safety, government and health care suggested that:

I. Essential textile and clothing content missing from the existing forms included:

   A. Accurate description of the fiber content; fabric weight, construction and surface characteristics.

   B. The design of the garment and the number of fabric layers.

   C. Care procedures and the age of the garment.

II. Methods of obtaining the missing content information included:

   A. Using a checklist format for the data form since the data collector does not normally have sufficient expertise to accurately identify the fabrics and fibers involved in the fire accident.

   B. Giving the victims and the caretakers the rationale of why textile and clothing information is needed to obtain their cooperation.

DEVELOPMENT OF DATA COLLECTION INSTRUMENT

The content, organization and format of the data collection instrument are discussed in this section. The

above mentioned points were the basis for the development of the instrument.

Instrument Content

The following facts were deemed necessary for inclusion in the instrument:

1. All garments or fabrics involved in the accident.
2. General "look" of the garment or outfit.
3. Specific apparel style.
4. Fiber content.
5. Hangtag and label information.
6. Fabric surface appearance.
7. Care procedures.
8. Garment performance during wear and care.

Sketches of general garment silhouettes for women's and girl's clothing were included, because of the variety in styles available today in women's clothing. (No sketches were included for men's garments since the design of men's clothing is perceived as relatively standard. Any deviation in the styling of the men's garments could be picked up through the sketches; i.e., full shirt sleeves.)

Since the average person cannot identify fiber content accurately, no listing of fiber contents was included. If the patient or caretaker cannot identify the fiber content from the label or hangtag information, he/she will be asked to guess. The caretaker of the patient is asked to recall any labels or hangtags which might have been on the garments, and to recall what information was given on the tags or labels.

The patient or caretaker is asked whether he/she knows the type of fabric, and differentiating between a knit or a

woven and a single or multiple layered fabric. The fabric's surface appearance was divided into three categories--texture, luster and body/drape--to determine the general fabric characteristics.

The type of care procedures used on the garments involved in the accident were deemed necessary information as many flame-retardant fabrics have the flame-retardancy deactivated by certain types of detergents and soaps (LeBlanc and LeBlanc, 1973). The respondent is therefore asked to identify the types of detergent, soap, and bleach that were used on each garment laundered.

Emphasis was placed on the number of layers of the total outfit worn by the victim and the number of layers of the individual fabrics. There is some evidence that double layers of some materials burn faster than single layers (Miller, 1973). Performance characteristics were included as the "last ditch" effort to establish a fiber content or a fabric construction. Certain performance problems are associated with certain fibers and certain fabric constructions. (For example, acrylic is associated with pilling problems; rayon and acetate with wrinkling; single knits with stretching or sagging.) The age of the garment is determined by merely asking the caretaker or victim.

Instrument Organization

The organization of the data collection instrument is designed from general to specific characteristics of clothing and textiles involved. The general, overall "look" or fit of the garment(s) is requested first, followed by the specific garment design details, including sketches for women's and girls' garments. In order to include multiple garments involved in a burn accident on the one form, a numbering system is used. The individual garments are referred to by number throughout the entire report form.

The instructions to accompany the instrument include the reasoning behind the necessity of collecting the textile and clothing information. Special emphasis should be made on the fact that with more precise information about textiles and clothing involved in fire accidents, superior standards can be formulated to reduce the number of such accidents in the future.

Instrument Format

The forms used by the National Burn Information Exchange (NBIE) and the Food and Drug Administration (FDA) differ in the type of information requested. Both forms have sections for description of the fabrics involved in a fabric fire (See Appendix D). Both forms follow the same general format--a table which is filled out by the data collector. An open-ended format is used; however, the resulting information does not reveal a total description.

Garment type and the brand name of the fit or design procedures are not requested with either of these forms, nor is the age of the garment. Therefore the complexity of interaction among the garment design, fiber, and fabric construction cannot be reflected from these forms.

The NBIE form refers to a coding system. The code is a list of reference words for "garment type", "nongarment type", "fabric type", and "construction of fabric". Another listing, which was not available to the writer, includes code numbers used for the various garments and fabrics. A system such as this would be efficient if one person did all the data collection and was thoroughly familiar with the code. However, according to the data collector for both St. Joseph Mercy Hospital and University Hospital in Ann Arbor, Michigan, even those hospitals associated with the NBIE do not all have only one data collector. The Institute for Burn Medicine encourages all members to assign data collection to one individual, but the size of the burn facility and the amount of funding available limits individual member's ability to comply (Hubbard, 1973).

Since it is not always possible to regulate who collects data, a more efficient format than the open-ended style is needed. Recognition is an easier form of identification than recall (Ebel, 1965). Therefore, for those data collectors who are not permanently assigned the task of obtaining information, a checklist format designed to

include major garment types and characteristics, was adopted in this study (See Appendix D for instrument).

The listing and questions for each factor considered were tested on a person not trained in textiles and clothing for clarity.

TESTING OF INSTRUMENT

Introduction

The procedures which were used in testing the data collection instrument are described in this section. The instrument was first refined with the help of a potential data collector previously interviewed. It was then tested by data collectors from the University of Michigan University Hospital, Ann Arbor, Michigan; and E. W. Sparrow Hospital, Lansing, Michigan.

Refinement of Instrument

When the instrument was in a useable form, it was pretested with one of the potential data collectors interviewed previously, in order to determine:

1. If the format, organization and content of the instrument could be understood and used by a nontechnical hospital staff person;
2. Whether the instrument yielded the desired data.

The terms used in the instrument were understood by the data collector and the flow of the questions was logical for her. She was able to adequately describe all the garments of an outfit which her youngest daughter had

worn to school that morning. (No burn victim had been admitted to the hospital in about a year.) The results of the pretest determined:

1. The terminology used was sufficiently non-technical to be understood by a person not trained in textiles and clothing.
2. The instrument form was easy to fill out.
3. Apparel items involved in fire accidents could be adequately and easily described.

Improvements suggested from the pretest situation which were incorporated into the instrument were:

1. A coding system in order to account for all garment items (See Appendix D for instrument).
2. Additional item descriptions.
   a. Adding "underwear" and its fiber contents to the list of apparel items.
   b. Adding "medium weight" to the list of fabric textures.
   c. Providing a "top/bottom" differentiation for fit of garment.

Test Situation

The two testing situations selected for this study were:

1. University of Michigan University Hospital in Ann Arbor, Michigan.
2. E. W. Sparrow Hospital in Lansing, Michigan.

These hospitals were chosen for two reasons: 1) both have Burn Units and would admit more burn patients than a hospital without a Burn Unit, and 2) they were easily accessible to the investigator. Both hospitals' Burn Units are associated with the National Burn Information Exchange (NBIE). There were, however, significant differences between them:

1.a. University Hospital was one of the original members of NBIE. The data collection system there has been in operation since prior to 1964, when the NBIE was founded.
b. The Burn Unit at Sparrow Hospital has only been connected with NBIE for about a year now. The data collection system in use at Sparrow is not as organized as it is at University Hospital.

2.a. One person is responsible for all the data collection at University Hospital Burn Unit.
b. At Sparrow Hospital, data collection is done by whoever is available.

3.a. University Hospital Burn Unit uses the NBIE report form which includes a section on clothing and textiles involved in the fire accident.
b. Sparrow Hospital Burn Unit does not use this report form, but keeps its own log, which does not include information on the clothing and textiles involved in the fire accident.

4.a. University Hospital Burn Unit is connected to the Burn Unit at St. Joseph Mercy Hospital in Ann Arbor, Michigan. The facilities for caring for burn patients at these two hospitals are extensive. They receive a large number of burn cases from hospitals throughout Michigan and surrounding states.
b. The facilities at Sparrow Hospital are quite small, when compared with those in Ann Arbor. The burn patients received at the Sparrow Burn Unit tend to be predominantly from the Mid-Michigan area. Therefore, a smaller number of burn cases is involved.

Both data collectors were giving the information from memory. The data collector at University Hospital had her memory prompted by samples of the actual garments the victims were wearing. The data collector at Sparrow Hospital had no samples of clothing. However, since the Burn Unit there had been functioning for only about a year, she had little trouble recalling what most victims had been wearing at the time of the fire accident. She

only filled out forms for those patients which she clearly remembered.

The data collector at Sparrow Hospital filled the forms out herself. The data collector at University Hospital asked the researcher to act as secretary, as she was handling the charred remains of the fabrics and it was inconvenient for her to write.

Retest Situation

The data collector at Sparrow Hospital was asked to retest the data collection instrument. The nonexperienced data collector represented the more typical data collection environment, and her retest situation was an important indicator as to how reliable a majority of the results would be. The likelihood of a nonexperienced data collector was substantiated through the correspondence and interviews with Buchbinder, Jones, James, Krafny and Hubbard (1973).

For the retest, the instrument forms were left with the data collector, for her to complete at her convenience. In the actual test situation, the researcher remained with the data collectors to answer questions.

SUMMARY

The basis for development of the supplementary instrument to collect data about textiles and clothing involved in fires was derived through interviews,

correspondence, and interview schedules; with professionals from the textile industry, fire safety, government, health care and education fields. The information obtained from these sources indicated that a supplementary data collection instrument was needed to determine the complexities of the factors involved in clothing fire accidents. The type of content information which is needed was obtained from these sources as well as an indication of the format and the organization which would elicit the most accurate responses from non-technical data collectors.

The supplementary data collection instrument was developed to obtain the information and to account for the variation that can be expected in data collection procedures and data collectors from hospital to hospital. This was accomplished through use of a checklist format, nontechnical language, and instructions which may motivate the data collector to complete the form.

The data collection instrument was designed to offer significant improvements in the quality and amount of information gained concerning the clothing and textile involvement in fire accidents than that which is not obtainable from the FDA and the NBIE forms.

The testing and the revision of the instrument took place in three stages:

1. The refinement with a potential data collector to determine the clarity of the instrument.
2. The test with an experienced data collector at University Hospital and with a nonexperienced data collector at Sparrow Hospital.

3. The retest with the nonexperienced data collector at Sparrow Hospital.

The clothing and textile information obtained with this data collection form does not show the complete picture of a clothing fire accident. The interrelationship among numerous variables such as the activity the victim is involved in when ignition takes place, the source of ignition, the environmental conditions, the design of the clothing and fabric, the fiber content of the clothing, and the action of the victim after ignition takes place, influences the severity of the burn accident. The purpose of this study was only to investigate the clothing and fabric related variables in the clothing fire accident, since information about the other variables is adequately covered in the FDA and NBIE forms now in use. Since the flammability standards which have been adopted, and those under consideration, are end-use garment oriented, the clothing and fabric variables in the actual clothing fire situation need to be adequately described to act as a guide in order that standards will provide the most safety. Therefore, the focus of this study was primarily on the involvement of the textiles and clothing in the clothing fire accident to gain information not now available.

CHAPTER IV

RESULTS AND DISCUSSION

In this chapter the results of the instrument development and testing are discussed. The first section includes a description of the validation process used in the development of the supplementary data collection instrument. Next, the results of instrument test-retesting are included, followed by a presentation of data collected at University of Michigan University Hospital in Ann Arbor, Michigan; and E. W. Sparrow Hospital in Lansing, Michigan.

VALIDITY

Face validation was the only type of validity testing performed since there were no established criteria available against which to evaluate the supplementary data collection instrument. Jones (1973) of the Bureau of Product Safety, stated that no set of criteria was used in the formulation of the data collection form used by the Food and Drug Administration (FDA). It was developed to meet the requirements of the research needs of the Department of Health, Education, and Welfare. The only other data collection form in use, that of the National

Burn Information Exchange (NBIE), was formulated on a set of medical criteria (Feller and Crane, 1970).

The concept of evaluating the validity of a test at face value is a subjective one. However, the researcher wanted to determine the extent to which the supplementary data collection instrument contained relevant content items, which would allow a more accurate description of clothing and textiles involved in fires.

The content to be included on the data collection form was determined according to the procedures discussed in Chapter III. There was agreement among representatives from the textile industry, government, and fire safety fields as to which items should be included for use in establishing fire safety programs. Content agreed upon as necessary included: design of garment and the number of layers, fabric weight, construction, surface characteristics; and care procedures used, as well as the age of the garment. There was also agreement among three textile and clothing faculty members as to the completeness of the items covered, terminology presented, and use of checklist format.

The instrument evaluation by the data collectors, one experienced and one nonexperienced, resulted in consensus that the form was usable. Several garment and nongarment categories, which the data collectors had observed from clothing fires, were added to the instrument; plus order of the questions was changed to go from general to specific, based on observation of how the data

collectors used the form. In addition, one question not easily answered by the data collector was clarified through examples. The data collectors agreed that the checklist format could easily be followed and would adequately describe all the apparel items involved in clothing fires. The data form was deemed viable for the hospital situations as it only took two to three minutes to fill out. Therefore, face validity was established to a degree, through:

1. Correspondence and interviews with professional concerned with the problem of fabric flammability for content to be included.
2. Evaluation of the instrument content, format and organization by university level clothing and textile faculty.
3. Data collectors use of the instrument.

RELIABILITY

The test-retest method for reliability was selected to demonstrate reliability of the data collection instrument. The non-experienced data collector at E. W. Sparrow Hospital was chosen for the retest situation, as the non-experienced data collector represented the more typical data collection environment. The binomial distribution was used to test for reliability.

The instrument, in general, proved reliable with six of eleven items showing reliability. The five items not reliable on the data form may be due to:

1. The data collectors' reliance on recall for the details of the garments involved.

2. The instructions for the data form were given orally in the test situation, but were written and read by the data collector in the retest situation with no explanation from the investigator.

The first point above might account for the discrepancies in the items concerned with the fit of the garment, fabric texture and luster. The second factor above did account for the majority of the discrepancies in items 4 and 6A regarding the fiber content and the type of fabric. In these items, the data collector consistently rated the burn victims' underwear in the first situation, and did not, as according to the written instructions, in the second situation.

Table 1

Results of the Retest Reliability

1. General look of the outfit	
A. Single-layered or multi-layered	$p = 0.031$*
B. Fit	$p = 0.3$
2. Garment type	$p < 0.0001$*
3. Lined or unlined	$p = 0.031$*
4. Fiber content	$p = 0.3$
5. Garment label information	$p = 0.031$*
6. Fabric type	
A. Woven or knit fabric	$p = 0.3$
B. Single- or multi-layered fabric	$p = 0.031$*
7. Fabric surface appearance	
A. Texture	$p = 0.67$
B. Luster	$p = 0.35$
C. Body/drape	$p = 0.1$*

*Reliable because $p < 0.1$

DATA COLLECTED

The results of the data collected with the instrument are reported here to point out the potential of the instrument in obtaining relevant data. Frequency counts were recorded of the apparel and nonapparel items involved in the clothing fire cases sampled. Although the number of cases was limited, definite trends appeared.

The sex of the victim was not originally included as a part of the study, but it is noteworthy that approximately 70 percent of the sample cases involved males. This is higher than the national total where the proportion of males to females is 60:40 (U. S. Department of Health, Education and Welfare, 1971).

General Appearance of Outfit

In the 23 clothing fire cases sampled, single-layered outfits appeared more often than the multi-layered shirt/slack garment combinations involved in the fire accidents accounted for the greatest frequency of single-layered items. The higher ratio of shirts/T-shirts, slacks/blue jeans (33 of 50 items) was due perhaps in part to the greater number of males than females in the sample. Related questions which have implications in the area of fabric flammability and the establishment of end-use standards in certain areas are indicated:

> Are shirts/slacks type combinations involved more often because men are more likely to be involved in a clothing fire accident (perhaps due to their activities)?

Or are men involved in more clothing fire accidents because their clothing is more flammable than that of females?

Table 2

General Look of Outfit

	Ann Arbor 15 cases	Sparrow 8 cases	Total 23 cases
Layers			
Single	9	5	14
Multi	7	3	10
Total	16*	8	24
Fit			
Tight			
All	6	4	10
Top	3	1	4
Bottom	3	1	4
Loose			
All	5	1	6
Top	2	2	4
Bottom	1	1	2
Flowing	1	2	3
Other	0	0	0

*Tent and sleeping bag counted separately.

Tight fitting clothing accounted for approximately 60 percent of this sample. The site of ignition on a tight-fitted garment as opposed to a loose-fitted one, would add insight into a seeming inconsistency of these results with what is generally believed: that loose

fitting clothing is more flammable because of the availability of oxygen to support the flame. However, tight fitting clothing may be harder for the victim to remove once ignited, and may contribute to increased severity of the burns as a result (See Appendix D for Instructions to Data Collector for the definition of tight versus loose fit). Since men's clothing tends to be more closely fitted than women's, this factor too, could relate to the greater numbers of men than women involved in serious clothing fire accidents in this study.

Garment Description

In the following section, sleepwear, underwear, and other specific apparel items will be reported based on the sample data obtained of the garments involved in serious clothing fire accidents.

Sleepwear

A total of five sleepwear garments were involved in the clothing fire cases sampled. (Four adults and one not known.) Perhaps the low number of sleepwear involvement is a result of the small number of cases sampled. However, from the implications derived from the review of literature presented in Chapter II, this percentage of sample accidents involving sleepwear is representative. If true, then perhaps the Children's Sleepwear Standards should be reviewed as to whether they accomplish the purpose for which the standards were established--that is, significant reduction of the number of serious clothing fire accidents.

Underwear

In almost every case where underwear was involved in a serious burn accident, the underwear contributed to the severity of the injury. Perhaps greater injury resulted when underwear was involved, due to the combination of 1) the easily ignited fiber content (predominantly cotton in the underwear sampled), and 2) the tight fit of the underwear, which would make it difficult to remove.

Specific Apparel Items

A much larger proportion of the garments involved in these fire accidents were unlined (59 items) rather than lined (5 items). From the 23 cases reviewed, the majority of clothing (93 percent) involved in the reported accidents was lightweight, everyday clothing, which is not always lined. National statistics indicate (U. S. Department of Health, Education and Welfare, 1971), that over 70 percent of fire accidents occur in the home; therefore, the probability that lightweight, indoor clothing was involved in a majority of the sample cases is logical. Further, since individuals typically dress casually at home, where most accidents occur, the clothing in this study was not the flowing or frilly dressy-type garments associated with high flammability. Then too, people may be conscious of the fire-hazard, and thus more careful, when dressed in fuller apparel items than their everyday clothing.

Table 3

Garments Worn at the Time of the Accident
Listed in Decreasing Frequency of Total Occurrences

	Ann Arbor	Sparrow	Total
1. Underwear	11	5	16
Briefs	5	5	10
Shorts	5	0	5
Bra	1	1	2
Cotton	7	6	13
Nylon	0	1	1
Polyester/Cotton	1	0	1
2. T-shirt	7	6	13
3. Shirt/Blouse	6	4	10
4. Non-apparel item	7**	0	7
5. Slacks	4	2	6
6. Bluejeans	2	2	4
7. Other	0	4*	4
8. Socks	4	0	4
9. Dress	0	2	2
10. Nightgown	1	1	2
11. Pajamas	2	0	2
12. Diaper/Diaper shirt	0	2	2
13. Sweater	1	0	1
14. Shorts	1	0	1
15. Jumpsuit	1	0	1
16. Sports Coat	1	0	1
17. Jacket	1	0	1
18. Long Coat	0	1	1
19. Housecoat/Bathrobe	1	0	1
20. Slippers	1	0	1
21. Overalls	0	0	0
22. Rompers	0	0	0
23. Skirt	0	0	0
24. Jumper	0	0	0
25. Suit	0	0	0
26. Sleeper/Sack	0	0	0
Lined	5	0	5
Unlined	35	24	59

* 1 Apron
2 Rubber Pants
1 Leotards

** 1 Sleeping Bag
1 Tent
1 Bedspread
1 Sheet
1 Hearing Aid Band
1 Curler
1 Blanket

Fiber Content and Fabric Appearance

Fiber

A much higher proportion of cotton fiber was mentioned than any other fiber in the accident reports. Krafny (1973), of the National Bureau of Standards, said he had observed that a fabric with any amount of cellulosic fiber in it, would burn like a cellulosic. This viewpoint has not been substantiated by research. However, if additional fiber-content data supports the above statement, then perhaps, standards might be fiber-related standards, in combination with end-use standards. In other words, any fabric with a cellulosic fiber content might be required to have a flame retardant finish.

Although there was no indication of the extent of melting fibers in the cases sampled, the role that thermoplastic synthetic fibers (e.g. nylon, polyester, acrylic, etc.) play in the burn injury should be studied. Melting fibers have the potential to fuse to the skin and would seem to influence the seriousness and extent of injury.

Table 4

Fabric Construction

	Ann Arbor	Sparrow	Total
Woven			
Loose	1	0	1
Tight	26	14	40
Knit			
Loose	0	0	0
Tight	18	8	26
Single-Layer	48	24	72
Multi-Layer	4	0	4
Double Knit	0	0	0
Double Woven	0	0	0
Bonded	0	0	0
Foam	1	0	1
Quilted	2	0	2

Fabric Structure

Tightly woven and tightly knitted fabrics accounted for the primary construction processes used in the fabrics sampled. (Approximately 60 percent were woven; 40 percent knit.) The tightness of the construction did not seem to cut off oxygen-support for the flame in the fabrics sampled when they were light to medium weight. The oxygen availability, therefore, is not necessarily as dependent on a fabric with a low yarn count, as on the surface-to-depth ratio of the fabric.

Very few multiple-layered fabrics (five percent) were involved in the cases sampled. Two of the multiple-layered

samples involved were quilted fabrics. With a quilted material, fire could become trapped between the fabric layers, and spread or smoulder in the fiberfill. If the victim was unaware of the presence of the fire, the spread of the flame between the fabric layers could result in more extensive injury to the victim.

Table 5

Fabric Characteristics

	Ann Arbor	Sparrow	Total
A. Texture			
Heavy/Thick	4	3	7
Light/Thin	31	10	41
Medium	13	9	22
Rough	0	2	2
Smooth	14	9	23
Soft	3	8	11
Stiff	1	2	3
Nubby	0	0	0
Velvet	0	0	0
Fuzzy	5	0	5
Flocked	0	0	0
Fiberfill	2	0	2
Other	0	0	0
B. Luster			
Shiny	1	1	2
Dull	37	6	43
Subdued	4	0	4
C. Body/Drape			
Stiff	1	3	4
Clingy	0	3	3
Flowing	2	2	4
Coarse	0	0	0
Average	38	12	50

Limited Data

Data on the aesthetic characteristics of the fabrics involved in the fire accidents, and the care procedures used on the garments are limited in this sample. The data collectors had difficulty in identifying the fabric appearance due to damaged samples or inavailability. The other information not obtainable was that unknown to the data collector, and only available from the caretaker or the victim.

Aesthetic Appearance

The data collected on the texture, luster, and body/drape are incomplete. Frequently, the fabric of the garment was so charred or so soiled from smoke, that the data collector could not determine the original appearance of the fabric. Such appearance-related information would probably be known to either the burn victim or the caretaker. Therefore, if information about the clothing and textiles involved in fire accidents was collected soon after the accident, with the victim or caretaker as the information source, perhaps more complete garment and fabric details would be available--the respondent would likely have increased recall of the details.

From the limited amount of information which could be determined about the fabrics concerning texture, luster, and body/drape, the trend seemed to be toward smooth surfaced fabrics, rather than fabrics with a pile or a nap

Table 6

Label and Care Information

	Ann Arbor	Sparrow	Total
Hang Tags			
Yes	17	0	17
No	5	0	5
Information			
Fiber	12	0	12
Manufacturer	18	0	18
Other	2	0	2
Care			
Laundered	34	23	57
Dry Cleaned	4	0	4

effect; a dull luster; or average body/drape. These properties present are consistent with the frequency of everyday clothing involved in most of the reported fire accidents. Shirt/slacks type garments tend to have a smooth surface, dull (or perhaps subdued) luster, and average body/drape.

Care Information

Information on hangtags and labels about laundering procedures and garment performance would be more likely known to the burn victim or caretaker than the hospital data collector. Thus, while the data collector could not provide such information to any great extent, it could probably be determined if the instrument were used as planned; i.e., as a supplementary form to other data

collection instruments, that are used shortly after the accident.

The data collector at University Hospital had recorded all label information from the garments she reviewed; therefore, some information was available for this study. Information which she had found on the labels included predominately the name of the manufacturer, and some fiber content information, which was discussed above in the section on Fiber Content and Fabric Appearance. The new Federal Trade Commission ruling on permanently attached care labels has some implications in the area of clothing fire safety. If the care label remains readable after the accident, knowledge of the care instructions could provide a means of general fiber identification, allowing determination of synthetic versus man-made cellulosic fibers; plus determination of care procedure that might affect a flame retardant finish.

SUMMARY OF THE DATA

Even with the unobtainable data particular trends appeared regarding the clothing and textiles involved in fire accidents. Light-weight, single-layered, tightly constructed fabrics, typically found in everyday close-fitting garments, were involved in the clothing fire accidents reviewed more than any other combination of elements.

Although location or situation of the accident was not included as a part of this study (since it is collected from the forms now in use) this information was made available to the writer by the data collectors during the testing situation. Accidents tended to happen in the home, which would account for the everyday (as opposed to dressy) lightweight, single-layered apparel.

Males were involved in more fire accidents than females in this study. Since men's clothing styles are, as a whole, more tight fitting than women's clothing, the results were consistent.

Information about the characteristics of the garments and fabrics involved in fires, which can be obtained through the instrument developed in this study, can be used in setting further end-use standards and other fire safety programs. With additional information, end-use standards could better be made to serve the purpose of protecting the consumer from the hazard of fire, without over-burdening him/her with the high cost of flame-retardant finishes and fibers when it might not be necessary.

Of course, fire safety is not entirely dependent on flame-retardant clothing. Standards regulating the most frequent sources of ignition, for example, might decrease the number of fire accidents much more quickly than flame-retardant clothing.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS

This chapter is divided into three parts. In the first section conclusions from the results of the study are presented; the second section is a discussion of the limitations of the study. In the last section implications are explored for use of the instrument and future associated activities.

CONCLUSIONS FROM STUDY

As a result of developing the data collection instrument, three major conclusions were reached:

1. Adequate details about clothing and textiles involved in fire accidents are not identified through the two existing data forms--the Food and Drug Administration (FDA) form and the National Burn Information Exchange (NBIE) form.

2. Additional information is needed on the role of the interrelationships among

   A. Garment design, including the number of fabric layers.
   B. Fabric characteristics, including the weight, construction, and surface characteristics.
   C. Care procedures used and for how long, i.e., age of garment.

3. Part of the information missing from the two existing forms can be collected with the supplementary form developed in this study.

These conclusions support the purpose of this study--to develop a data collection instrument for clothing and textiles involved in clothing accidents.

LIMITATIONS OF STUDY

Sample Size

A small, localized sample was used for this study. Two data collectors tested the instrument recording clothing information from memory, with the aid of hospital records on actual burn cases. A total of 23 burn patient histories were reviewed. Only two data collectors were asked to test the instrument because there are two large Burn Units in the area, each of which had one data collector available for testing. The other area hospitals did not admit enough burn patients per year to make instrument testing in those hospitals worthwhile.

Absence of Burn Victims for Interviewing

A further limitation was the method the two data collectors used to complete the instrument. They had to fill in information from recall of what former burn victims had worn, since no burn patient or caretaker was available to interview. (There were no victims admitted to either of the Burn Units during the time of the interview schedule.)

To somewhat compensate for these circumstances, the data collector at University Hospital in Ann Arbor, Michigan,

used the patient's data chart and actual samples of the clothing to prompt her memory. For accuracy, only those cases for which clothing samples were available were used in this study. At E. W. Sparrow Hospital in Lansing, Michigan, the data collector had no clothing samples, but did use the data charts to prompt her memory. Since the Sparrow Burn Unit had only been in operation for about a year and the data collector could recall, with demonstrated certainty, the fabrics and garments involved in the accidents, only those patients the data collector could distinctly remember were used.

Another limitation of the after-the-fact data collection, was that the data collectors did not have complete enough information to answer all questions. Certain questions on the data instrument require information known only to the victim or caretaker. For example, laundering and care procedures used, performance of the garment during use, and possible hangtags or labels attached when the garment was purchased, would have to be reported by the owner.

However, despite the limited sample and incomplete data, trends appeared regarding the garment styling and the fabric structure characteristics. These trends were discussed in Chapter IV.

IMPLICATIONS

Implications resulting from the development and testing of the data collection instrument are discussed under three sections: 1) The use and diffusion of the instrument, 2) Programs for improved fire safety, and 3) Future research.

Use and Diffusion of the Instrument

The instrument developed in this study is not meant to be used in isolation. The supplementary data form is meant to be used in conjunction with either the National Burn Information Exchange (NBIE) form or the Food and Drug Administration (FDA) form. Only by analyzing the textile and clothing information in relation to the environmental factors of a clothing fire, will the total picture of a clothing fire accident be viewed.

In order for the supplementary data collection form to fulfill the purpose for which it was developed--to obtain information on clothing and textiles involved in fire accidents--the collection of non-medical information on burn patients must be supported by hospital administrators. (Possibilities for promoting acceptance and dissemination of the instrument suggested by the hospital administrators interviewed were presented in Chapter III, also see Appendix A for interview schedule.)

The willingness of the hospital administrators and physicians to cooperate depends in large measure on how much

information they have about the complexities of the burn problem. A person, group, or agency should assume responsibility for informing hospital administrators about the severity of the total burn problem, and offer suggestions on how individual hospitals can contribute to the burn information bank.

Small local hospitals in areas not served by hospitals with burn units, might also be encouraged to join in a cooperative effort for data collection. Since many burn units have adequate support to provide for collection of information about burn victims, a type of "reward" system, such as paying the small hospitals to collect information on burn victims would lessen their financial burden. Government is a logical source for funding support due to the nature of the problem, and the legislation and standards involved. In view of the small number of seriously burned victims (approximately 0.06 percent of the total population), the likelihood for adequate research funding is doubtful. However, with the recent government emphasis on flame-retardant clothing and the setting of end-use standards, some attention must be paid to the fact that standards are being set in spite of inadequate information on the complexities of clothing fires. There is a need for more research in this area to enable workable programs to be established which will, in fact, decrease the severity of burn accidents.

With potential increased amounts of information collected by various hospitals on clothing fire accidents, a national clearinghouse is needed to analyze the data. The National Bureau of Standards (NBS) currently serve as clearinghouse for fire victim data collected by contract agencies subsidized by the Food and Drug Administration (FDA). The NBS must have additional allocated funds to expand its facilities and accommodate data from noncontract sources. The National Burn Information Exchange (NBIE) submits burn data to the NBS when fabric samples from the fire accidents are available. Although the NBIE is not now funded by the FDA to do extensive data collection on burn cases, it was at one time.

Since the future points to increased flammability standards for end-use garments, a systematic processing of the information about clothing and textiles involved in fires is greatly needed. The collection of burn information would serve no purpose unless the data are analyzed and disseminated to the appropriate government and private agencies working toward the reduction of the number and the severity of clothing fire accidents. The NBS can offer an organized data bank where the interrelationships among the variables of a clothing fire, can be analyzed. Only in this way would the appropriate end-use standards and other safety programs be developed in order to achieve the goal of reduced numbers of burn accidents.

Programs for Improved Fire Safety

In the following section, several avenues for improved fire safety are discussed. The first part touches upon possible end-use standards, followed by suggestions for new fire safety education programs. In the last part, consumers attitude toward flame-retardant finishes is discussed.

End-Use Standards

This preliminary study indicates that accurate information on the role played by clothing and textiles in fire accidents can possibly be obtained from the data collection instrument developed. Such information can provide a basis for more realistic end-use standards or for establishment of other fire safety programs. End-use apparel and interior furnishing standards may prove to be a less satisfactory method of providing fire safety for the consumer than other programs or standards regulating the most frequent sources of ignition, such as ranges, smoking devices and space heaters (U. S. Department of Health, Education and Welfare, 1971).

Fire Safety Education

When considering the activities of victims immediately prior to the accident, the greatest causes of clothing fires seems to be carelessness, ignorance, and stupidity on the part of the victim; or in the case of a very young child, on the part of the parents. The circumstances point

to the need for consumer education programs, directed especially toward parents and children. Such programs could be incorporated into school curriculums for students of all ages: the nursery school child should be alerted to the dangers of fire and what fire can do, as much as the high school student. Education of the children might also act to inform parents of the hazards of carelessness around fire. Most children are fascinated by fire and flame and do not realize its potential dangers. Parents need to be educated to not only act to prevent potentially hazardous actions by their children, but to be able to cope with the fire situation in the most efficient manner, should the situation arise.

One area which should be re-evaluated in the education of children and adults concerning fire accidents is the course of action a person should take when clothing is ignited. Educational courses still teach that a person whose clothes have been ignited should wrap or roll a blanket or a rug about oneself. This course of action was fine when rugs and blankets were made of wool, a self-extinguishing fiber. However, today, many blankets and rugs are made of thermoplastic, synthetic fibers (which will melt and in some cases support combustion) and do not have the same self-extinguishing properties as wool. Many synthetic fibers used in blankets and in rugs, especially acrylic, will ignite readily when exposed to the flame and can create severe burns by melting into the skin. Thus, if

a victim is wrapped in a synthetic blanket or rug, the already burning clothing may ignite the thermoplastic rug or blanket, resulting in fiber melting and increased severity of injury. Instead, perhaps, a new approach should be taught--the removal of the ignited clothing, rather than attempting to extinguish the flames by wrapping the victim in a convenient blanket or rug. Burned hands heal more rapidly than a totally burned body; and by removing the flaming garment, quite possibly, the hands would be the most severely burned part of the body. New education techniques might inform children and adults that fabric has the potential to burn if it is exposed to a source of ignition, and that the classical method of extinguishing a clothing fire is not applicable today with the increased numbers of melting, synthetic fibers in apparel. Education does not always keep up with the advances in technology. Therefore, new programs need to be developed to emphasize methods of dealing with the increased numbers of thermoplastic, synthetic fibers and the flame-retardant fabrics available on the market in apparel today.

Directions for Improved Fire Safety

At this point in time, garment end-use standards seem to be a focus for fire safety programs. Garment end-use standards are not a cure-all. Standards of this sort do not treat the source of the problem, only the symptom.

The standards may prevent a small number of clothing fires which would have happened if, for example, a child had not had flame-retardant pajamas on. More in depth study is needed of the total environment complexities of a clothing fire in order to know where regulation will be the most beneficial.

If, however, these standards are to be a central feature for improved safety, additional measures must be followed to allow the standards to have as great an impact as possible. Textile technologists must develop quality flame-retardant finishes which meet consumer expectations in terms of fabric aesthetics and price. Consumers must be re-educated to accept the advantages and trade-offs of flame-retardant products. The consumer has accepted textile trade-offs in the past; for example, durable press was accepted when it meant decreased durability, etc., in exchange for ease of care. If the consumer is to accept trade-offs that currently come with flame-retardant finishes, i.e., stiffer hand and decreased durability, the consumer will have to realize the value received in return.

A review of literature indicates that consumers do not now perceive the value of flame-retardant finishes. Arguments used by consumers as to why flame retardant finishes are not necessarily a benefit for everyone include that not everyone smokes; that matches are not always readily available in the homes that have no smokers or appliances that require lighting; and that if a building

goes up in flames, a child's fire-retardant pajamas would not contribute much protection. Improved technology for flame-retardant finishes can help decrease the severity of an accident in some circumstances, i.e., retarding the flame spread on a garment of a very old person or a very young child. But standards for flame-retardant fabrics alone do not appear to solve the total problem.

Future Research

If the instrument developed in this study is to be used nationally, development, refinement, and operationalization cannot stop here. This instrument should be tested in actual data collection situations to determine if all needed textile and clothing information can be obtained. With expanded information, relationships among the variables of a clothing fire can be analyzed statistically. Thus, causal variables can be identified, and preventive programs instigated by the government can be developed to truly decrease the number of seriously burned victims resulting from clothing fires.

In order that the data collection instrument developed in this study fulfills the purpose for which it was developed--to offer a method of textile and clothing data collection in order that more details be known about the complexities of clothing fire accidents--the instrument must be diffused among various hospitals across the United States. The diffusion of the instrument to a number of

hospitals would provide additional data, and would determine if a wide variety of data collectors could use the instrument successfully.

Future projects might involve expanding the textile expertise of the data collectors. With increased understanding of textiles, data collectors could more accurately help the burn patient or the caretaker identify the fabric and fiber involved in the fire accident. A short programmed sequence of instruction on basic textile terminology, specifically dealing with aspects which might be encountered in a clothing fire, could be developed. The programmed sequence might include general familiarity with fiber and trade names, fabric identification, identification of finishing techniques which influence flammability (e.g., flocking or napping), and experience with a fiber identification burn test. When the idea of a programmed sequence was mentioned to data collectors, they were very enthusiastic. The sequence must be kept, of course, to a length which would be realistic in terms of the data collector's other duties.

SUMMARY

Interest in the development of the data collection instrument for clothing and textiles involved in fires was generated by the publicity surrounding the Children's Sleepwear Standards. The necessity for increased amounts

of data about the interrelationships among the variables in a clothing fire was substantiated by the review of literature. If additional standards are to be established, and the indication is they will be, then more information is needed to insure that the standards accomplish their objective--to significantly reduce the number of fabric-involved fires.

The instrument developed allows a hospital data collector who has little knowledge of textile terminology to collect information about the garment design, the fabric characteristics, and other pertinent information about the care and performance of the garment from the burn patient or the caretaker. This type of information is needed to provide the complete picture of the complexities of a clothing fire. Other environmental factors are already accounted for by the two data forms now in use. In the process of gaining information for the development of the instrument, the importance of gaining the acceptance of the instrument by hospital administrators was discovered.

Implications for use and dissemination of the instrument, as well as other types of programs to decrease the number of clothing fires, were explored in this study. Future research should involve further refinement of the instrument based on extensive use of the instrument in actual data collection situations. Then, statistical

analysis of larger amounts of data collected nationally, will hopefully contribute to a more complete understanding of the role of textiles and clothing in fire accidents.

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APPENDICES

APPENDIX A

APPENDIX A

ADMINISTRATORS

1. How many burn patients do you get a year?_____

2. Do you send the badly burned victims to Ann Arbor?_____
   Or do you deal with them yourself?_____

3. How familiar are you with the National Burn Information Exchange?_____
   _____

4. When is the medical information about the patient collected?_____
   _____
   At admitting?_____
   After treatment?_____
   Other?_____

5. By what method is the information collected?_____
   By interview?_____
   Taped?_____
   Oral-written?_____
   By questionnaire form?_____
   Other?_____

6. What type of person collects the information?_____
   Admitting personnel?_____
   Nurse?_____Head nurse?_____
   Doctor?_____Resident?_____
   Anyone available?_____
   Other? (specify)_____

7. Do individuals who collect this type of information accept the task as their specific responsibility?_____
   _____

8. From whom is the information about the patient collected?
   _____
   The patient himself?_____
   The parents of the patient?_____
   Any relative or friend?_____
   Other?_____

9. Is the form used for the collection of data the hospital's own?_____

Appendix A (Cont'd)

Is it a form accepted and used by many hospitals?_____

If so, what is the name of it?_____

10. Where do you think the responsibility lies for textile data collection concerning clothing fire accidents?_____

Individual hospitals?_____
A national organization?_____
Government?_____
Individual hospital membership in a national organization?_____

11. To what extent would you be willing for this hospital to cooperate in collecting information about textiles involved in clothing fire accidents?_____

12. To what extent do you think hospitals would cooperate nationally?_____

13. How might hospitals be encouraged to collect such information?_____

APPENDIX A

SUMMARY RESULTS
of Interviews with Hospital Administrators

HOSPITAL	Ingham Medical Hospital	St. Lawrence Hospital	Lansing General Hospital
Average number of burn patients per year?	10	11	16
Method of data collection.	Hospital's own.	Hospital's own.	Hospital's own.
When is data obtained?	After treatment.	At admitting or after treatment.	After treatment.
Who collects data?	Physician or head nurse.	Clerk-typist.	Physician or resident.
Specific responsibility?	Yes	Yes	No
Data obtained from whom?	Patient, parent, or guardian.	Patient, parent, or guardian.	Patient, parent or guardian.
Where should the responsibility lie for the collection of data on C and T in fires?	Individual hospital with a national clearinghouse.	National organization or government.	Individual hospital or physician.
This hospital willing to cooperate?	Very interested.	Would have no use for it.	Would be willing.

Appendix A (Cont'd)

	Ingham Medical Hospital	St. Lawrence Hospital	Lansing General Hospital
How to get other hospitals to cooperate?	Get MD's interested. Do it as a cooperative among local hospitals.	Assure hospital of organized data collection.	No comment.
How to encourage hospitals to collect data?	Show the significance of the data.	Allow voluntary regulation of procedures.	Pay them! Show accomplishments with data. Use the 'community' approach.

APPENDIX B

APPENDIX B

HOSPITAL PERSONNEL

1. Male_____ Female_____

2. Level of education completed?_____
   Type of institution?_____
   How long ago completed?_____

3. Position in hospital?_____

4. What contact do you have with a burn victim?_____
   _____
   _____

5. Are you familiar with the Childrens' Sleepwear Standards?
   _____
   (If not, the interviewer will state that the standards require childrens' sleepwear from sizes 0 to 6X to pass specific flame retardancy tests or, until July 1973, to be labeled as flammable.)

6. Do you think that standards of this type will help to decrease the number of clothing fire accidents?_____
   _____
   Why? or Why not?_____
   _____
   _____

7. What other programs, activities, standards do you think might be helpful to decrease the number of clothing fire accidents?_____
   _____
   _____

8. Do you think that consumer education programs might help decrease the number of clothing fire accidents?_____
   _____
   Why? or Why not?_____
   _____
   _____

Based on what you have just told me, and on discussions with other individuals involved with this problem, there is a need to have common meanings of textile terms in order to collect information about fabrics involved in clothing fire accidents. Different individuals have varied meanings for

Appendix B (Cont'd)

textile terms and place different importance on the role of fabrics involved in clothing fires. For example:

9. What does "fiber content" mean to you?_____
_____
_____

10. What is meant by "fabric construction"?_____
_____
_____
_____
_____

11. How would you determine the fiber content of a garment?
_____
_____
_____
_____

12. How would you find you the fiber content of a fabric involved in a clothing fire accident from a victim (or his parents, etc.) who did not exactly know what fiber content meant?_____
_____
_____
_____
_____

13. How would you find out the fabric construction under the same circumstances?_____
_____
_____
_____
_____

14. When do you think you could collect the most accurate information about a clothing fire accident from the parents of a child who had just been badly injured?
_____
_____
Why?_____
_____
_____

APPENDIX B

SUMMARY RESULTS
of Interviews with Potential Data Collectors

POSITION	Head Nurse Emergency	Head Nurse Emergency	Admitting Clerk
Sex	F	F	F
Education	Nursing school	Nursing school	Some college
How long age	19 years	25 years	40 years
Contact with burn patient	Initial	Initial	None
Familiarity with Children's Sleepwear Standards	Vaguely	None	None
Decrease accidents?	Somewhat, but why stop with pajamas	Yes, children play with matches	Somewhat, those accidents which do happen in sleep-wear will not be as critical.
Other possible programs?	Parent education.	All cothing nonflammable.	Change style of clothing to more close fitted.
Consumer education?	Will make parents aware of hazard.	Use advertisements as people pay attention to that.	Education will help. Parents will know what to do.
Fiber content?	What the fabric is made out of, like cotton or nylon.	What it is made out of.	What type of fibers are in it.

Appendix B (Cont'd)

	Head Nurse Emergency	Head Nurse Emergency	Admitting Clerk
Fabric construction?	How the fabric is put together. Ie., # threads per square inch, or the type of weave or knit	How it is made.	The way it is woven.
How to determine fiber content?	Read the label. Sometimes you can't tell by the feel.	Read label.	Read label.
How to get other to identify fiber content?	Prompting, i.e., was it cotton or synthetic?	Description of clothing and fabric.	Find out if they remember any labels or could guess whether it was cotton or nylon, etc.
How to get other to identify fabric construction?	Ask if it was loose or tight weave, summer or winter weight. Prompt with names.	By description.	Loose or tight weave or knit. Was it stretchy? Firm? Heavy? Was it washable?
When to collect information?	After the outcome is known. If too soon, caretaker won't see logic, will blame person who is collecting data for accident.	After everybody has had time to relax and calm down.	After parents have calmed down and child has been treated. Too soon, will resent interviewer. Need parents to have good attitude.

APPENDIX C

APPENDIX C

QUESTIONS CONCERNING FABRIC INVOLVEMENT FROM THE NBIE REPORT FORM AND FDA INVESTIGATION REPORT

38. Fill out the following table for each fabric ignited. Please enter the appropriate word and code number from the listings provided in the manual. Fill out one for each garment and each nongarment fabric.

	Garment Type	Brand Name	Fabric Type	Construction of Fabric	Comments
1.					
2.					
3.					
4.					
	Nongarment type				
1.					
2.					
3.					

From the National Burn Information Exchange Epidemiological Informations

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#15. Fabrics involved.

Items Involved A	Order of Ignition B	Sample Yes C1	Sample No C2	Brand Name D	Fabric Composition E	Fabric Construction F	Comments G

From the Flammable Fabric Accident Investigation Report. Used by the Food and Drug Administration.

APPENDIX D

APPENDIX D

DATA COLLECTION INSTRUMENT

INSTRUCTIONS TO THE DATA COLLECTOR:

The following section is designed to collect specific information about clothing and fabrics involved in fire accidents.

TO FILL OUT THE FORM:

1. Please explain to the respondent why this information is necessary. Such information is important because there is no other way of determining the extent to which clothing contributed to the fire accident.

2. Fill in all description which are applicable. Assign a number beside all garments worn at the time of the accident. Use these reference numbers throughout the form.

3. Add any details to the sketches which would show more accurately the design of the garment(s). Or, use your own drawings.

4. Only consider underwear in #2 unless there is something very unusual about it. (For example, do not consider underwear as a clothing layer in #1 or in the responses to #4 through #9.)

5. Definitions
   a. Single or multi-layered outfit refers to the <u>total</u> look of the outfit. <u>Not</u> to the individual garments.
   b. <u>Loose fit</u> refers to a garment which can easily be removed in a hurry. <u>Tight fit</u> cannot be removed easily, for example, anything which has to be unzipped or unbuttoned in order to get it off.

DATA COLLECTION INSTRUMENT

1. GENERAL LOOK OF OUTFIT
   ___Single-layered (one layer of apparel plus underwear)
   ___Multi-layered (two or more layers of apparel plus underwear)
   ___Tight fit (top, bottom)
   ___Loose fit (top, bottom)
   ___Flowing of full lines
   ___Other (describe)
   _____
   _____
   _____

2. Assign a number beside all the garments you (or the victim) were wearing at the time of the accident. Use these reference numbers for describing garment characteristics in the following blanks.

___Shirt/Blouse	___Long coat
___T-shirt	___Housecoat/Bathrobe
___Sweater	___Nightgown
___Slacks	___Pajamas
___Blue jeans	___Sleeper
___Shorts	___Sack
___Jumpsuit	___Diaper/Diaper shirt
___Overalls	___Other (describe)
___Rompers	_____
___Skirt	_____
___Dress	___Underwear
___Jumper	___Briefs ___Cotton
___Suit	___Shorts ___Nylon
___Sports coat	___Bra ___Poly/Cotton
___Jacket	___Non-apparel item (describe)
	_____
	_____

3. How would you describe the style of the garment(s) worn? (as applicable)
   ___Lined (top, bottom)
   ___Unlined (top, bottom)

   Outer wear:

___Sports coat	___Jacket
___Cardigan sweater	___Long coat
___Windbreaker	___Other (describe)
	_____

Shirt/Blouse:
___Shirt-type
___Smock
___Pull-over sweater
___Polo shirt
___Full sleeves
___Narrow sleeves
___Long sleeves
___Short sleeves
___Other (describe)
_____
_____

Dress:
___One (1) piece
___Two (2) piece
___Shirtwaist
___Shift
___Sheath
___High waist
___Dropped waist
___Other (describe)
_____
_____

Slacks:
___Wide leg
___Narrow leg
___Skirt-like (very full)
___Other (describe)
_____
_____

Skirt:
___Long (ankle length)
___Knee-length
___Short (mini)
___Full (gathered)
___Pleated
___Flared
___Straight
___Other (describe)
_____
_____

Suit:
___Man's or boy's tailored suit
___Woman's or girl's pantsuit

Sleepwear:
___Tailored pajamas
___Baby dolls
___Neglige
___Long nightgown
___Short nightgown
___Sack
___Sleeper
___Footed pajamas
___Robe
___Other (describe)
_____
_____

Trim:
___Ruffles
___Ties
___Lace
___Ribbons
___Embroidery
___Braid

Trim: (continued)
___Other (describe)
_____
_____
Location of trim
_____
_____
_____
___Was trim in continuous rows?

How old is the garment(s)?
_____
_____
_____
_____

4. Do you know the fiber content(s)? ___Yes ___No
If yes, what?_____
_____
If no, could you guess?_____
_____
Why do you think this is the fiber content?_____
_____

5. Do you remember if the garment(s) had any labels or hang tags on it? (Which one[s]?)_____
_____
What information was given on the tags?_____
_____
_____
Do you still have them?_____

6. Do you know the type of fabric(s)?_____
_____

___Woven
___Tight weave
___Loose weave
___Knit
___Tight knit
___Loose (lacy) knit

___Single-layer fabric
___Multi-layer fabric
___Double knit
___Double woven
___Bonded/Laminate
___Foam visible?
___Quilted

7. How might you describe the fabric(s)' surface appearance?
TEXTURE:
___Heavy/Thick
___Light/Thin
___Medium weight
___Rough
___Smooth
___Soft
___Stiff
___Nubby surface
___Velvet-like surface
___Fuzzy surface
___Flocked
___Other (describe)
_____
_____

LUSTER:
___Shiny
___Dull
___Subdued
___Other
_____
_____

___Fiberfill

BODY/DRAPE
___Stiff
___Clingy
___Flowing
___Coarse
___Average
___Other (describe)
_____
_____

8. What kind of care procedures have been used on the garment(s)?
Which garment(s) was washed?_____
Type of detergent_____
Type of soap_____
Woolite or other similar product_____
Which garment(s) was bleached?_____
Type of bleach_____
Which garment(s) was dryer-dried?_____
Did the garment(s) require ironing?_____
Which garment(s) was dry cleaned?_____

9. How would you describe the performance of the garment(s) during use?_____
Which garment(s) had problems with pilling?_____
Which garment(s) had problems with wrinkling during wear?_____
Which garment(s) had problems with snagging?_____
Which garment(s) had problems with stretching or sagging out of shape?_____
Any other problems?_____