

7. DISCUSSION

7.1 Representivity

The representivity of the sample is limited to the sectors selected, and by the fact that, for practical reasons, the study was restricted to Gauteng and the Western Cape. However, given the consistency of many results across sectors and sub-sectors, there is no reason to anticipate that results for other provinces or sectors would be much different. If anything, it is likely that the small but evident percentage (23 to 45%) of initial non-response amongst industry and transport companies in this study (which may bias the results upward – i.e. to better comprehensibility) and the relatively high level of economic development in these two provinces would tend to produce a slightly better picture than may be the case for the whole country, and therefore reflect a better-case scenario. However, as a starting point for considering the implementation of the GHS, this remains a useful snapshot to understand where priority efforts should be focused in future.

7.2 Labels and sources of information

- Labels were the most commonly identified unprompted information source for industry (52%), transport (61%), agricultural (60%) and consumer (64%) respondents and these percentages exceeded the next most common category of information source by two to threefold.

The data therefore indicate that workers and consumers regard a label as their priority source of information on a chemical. Amongst employed persons, job category made no difference to this preference.

- Instructions for use were cited by 41% of industry and agriculture respondents, 26% of transport respondents and 53% of consumers as their reason for using labels, being the most common response.

Thus, although labels were a key source of information, respondents' usage of labels appeared primarily concerned with obtaining instructions on how to use the chemicals, rather than to obtain safety information.

- Comparisons of past usage to future intended usage (Table 6.20) indicates that respondents would, after the interview, be much more likely (about two to three times) to seek hazard and safety information from the labels.

The GHS therefore can fill an important gap in information provision to workers and consumers.

- Occupational health practitioners and Poison Information Centres were uncommonly identified (less than 8% and 6%, unprompted, respectively) as possible sources, despite their skills and expertise. On prompting, laboratory / health care personnel, and safety representatives / shop stewards were more likely to identify occupational health practitioners as sources of information.
- Perceptions that Trade Unions could serve as sources of safety information were low (less than 4%, unprompted).

Despite multiple sources of information other than labels, few unprompted sources were identified by respondents. The fact that worker representatives concerned with safety appeared more aware of the role of occupational health practitioners is probably the result of greater contact with health care personnel at the workplace. It may therefore be possible to raise awareness of the role of occupational health practitioners in relation to chemical safety. Poor awareness of the role of Trade Unions as sources of safety information may reflect low unionisation in sample, or that the system put in place by current labour relations structures is not working adequately. As a source of information, awareness could be raised through Trade Union structures to improve knowledge and practices.

- Co-workers and supervisors were the categories that increased by the greatest amount when respondents were prompted as to sources of hazard information, across all sectors. These increases varied from 4- to 14-fold.

The data therefore demonstrate the importance of peers as a source of information, particularly co-workers and supervisors.

7.3 Training

- The percentage of respondents who have received training on labels in their current jobs was 41% of industry respondents, 56% of transport respondents, 21% of agricultural respondents and 12% of consumers.
- When taking any past training on labels into account, 56% of industry, 86% of transport, 34% of agriculture and 16% of consumers reported training on labels.
- Training on SDS's in current jobs was 34% for industry, 34% for transport, 11% for agriculture and 7% amongst consumers; in any job, past and present, training on SDS's was 44% for industry, 49% for transport, 19% for agriculture and 11% for consumers.
- Within the industrial sector, chemical company respondents reported higher rates of training: 50% for labels and 68% for SDSs.
- Training on SDSs was less common than on labels, except for respondents in the chemical industry.

These data demonstrate a significant gap in training. The data also suggest that for agriculture, training levels are so low as to approximate the levels found in the general non-working (consumer) population. Given the data on the importance of co-workers and supervisors above, there is a need for training and information availability that taps peer networks.

Even in the chemical sector, while higher, reported levels of training were not adequate, and certainly less than what is mandated by the Hazardous Chemical Substance Regulations. While some of the responses to the questions may not have been entirely accurate, it is unlikely that respondent bias in answering the questions would explain this entire shortfall. Training in the GHS should therefore clearly be a priority for action. Notably, mention of training substantially improved participation rates in the Comprehensibility testing. Therefore, wherever possible, future comprehensibility testing should ideally be linked to training in hazard communication.

7.4 Symbols

Symbols play a very important role in hazard communication.

- The highest percentages for items recalled (unprompted) on a label were elicited by symbols skull and crossbones (industry: 72%; transport: 76%; agriculture: 93% and consumers: 89%); flammable: (industry: 59%; transport: 57%; agriculture: 70% and consumers: 82%); environmental hazard (industry: 45%; transport: 44%; agriculture: 60% and consumers: 56%)
- Symbols were more commonly cited by consumers and agricultural workers, and the latter group have higher rates of non- or partial literacy.
- Symbols were also more likely to be read first when a label is seen: skull and crossbones was cited in the first three items recalled in 66% of industry respondents, 39% of transport respondents, 88% of agricultural respondents and 77% of consumers. This applied irrespective of category of job.
- The reason cited for perceived hazardousness of a chemical was most usually an association with the symbol on the label. On average, about 50% of respondents identified symbols as the reason for deciding on the hazardousness of a chemical, although this was higher (72%) for consumers.

Symbols are therefore key to attracting attention, and informing risk perception regarding a chemical.

- The percentage of correct or partly correct responses for GHS symbols was less than 50% for 6 symbols.

- Symbols scoring between 75% and 100% correct or partly correct were the skull and crossbones and flammable, across all sectors.
- Symbols scoring between 50% and 75% correct or partly correct were the symbols for corrosive (industry), environmental hazard (transport, agriculture and consumers), explosive (industry, transport, consumers), skin irritant (industry, transport, consumer). Other symbols scored less than 50%
- Compressed gas was the least comprehensible symbol outside the transport sector.
- Consumers understanding of the explosive symbol (71%) exceeded that of other sectors

Comprehensibility of symbols was highly variable. Other than the skull and crossbones, comprehensibility was weak or poor, particularly for symbols indicating chronic hazards, and for the compressed gas symbol.

Training and other interventions should therefore address symbols that have lower comprehensibility and not rely only on the two 'high performers.'

- Laboratory / health care workers had better comprehension of certain symbols (carcinogenic, oxidising) but poorer comprehension of others (corrosive). In general, however, there was little consistency in differences in symbol comprehensibility between categories of job, and for most symbols, differences were not statistically significant.

	More than 85% correct	Less than 5% critical confusions
Corrosive to skin and metal	No	No
Skull and crossbones symbol	Yes	Yes
Flammable symbol	Yes	Yes
Environmental hazard symbol	No	Yes
Explosive	No	Yes
Oxidising	No	Yes
Acute health hazard	No	Yes
Skin irritant	No	Yes
Reproductive health effects	No	Yes
Carcinogenic	No	Yes
Chronic	No	Yes
Compressed gas	No	No

In order to benchmark the results, US Standards¹⁰ for candidate symbols are listed in Table 7.1, which sets criteria for acceptance at 85% correct answers and less than 5% critical confusions.

Data in the table suggest that none of the symbols other than the skull and crossbones or the flammable symbol would achieve acceptable comprehensibility in terms of these criteria.

- A small number of respondents described hazard symbols in terms of other common usages – for example as in traffic signs.

This may be an obstacle to comprehension if people presume a meaning based on an entirely different context, but it may also present opportunities for training in hazard symbols to draw on other common usages to improve intelligibility.

- In response to the symbol indicating reproductive hazard, one respondent thought the symbol indicated an effect beneficial to reproductive capacity.

It is therefore important to ensure that the negative message of a warning symbol is adequately conveyed by the symbol or through training.

¹⁰ General Procedures for Evaluating Candidate Symbols. ANSI Z535.3-1998, Annex B: pp30.

7.5 Pictograms

Comprehension of symbols used in pictograms gave a different pattern to that for hazard symbols

- Advisory pictograms (use of different forms of PPE, washing hands) were generally well understood. Correct or partly correct responses exceeded 90% for use of gloves, boots and respirator, and for washing hands after use, for all sectors.
- Activity pictograms for pesticides, which carry information about activities (e.g. mixing circumstances) and environmental hazards, had lower frequencies of correct answers, and incorrect or don't know exceeded correct answers.
- Pictograms denoting environmental hazards yielded comprehensibility that was similar to those for pesticide activity pictograms.

Although these latter questions were only asked of consumers and agricultural workers, it is unlikely that industrial or transport workers would have fared any better. In any event, comprehension of the PPE pictograms was broadly similar in all sectors.

7.6 Signal words

- The signal word 'danger' was ranked as conveying a higher level of hazard than 'warning' by most respondents, irrespective of sector.
- 'Danger' was more likely to be associated with the perception of a health risk than 'warning.'

Signal words are an important element of the GHS. Data in the study confirmed popular understanding of the GHS usage of 'danger' to denote a more serious risk than 'warning.'

7.7 Hazard phrases and words

Comprehension of hazard phrases and words varied widely.

- Forty-six percent of respondent indicated the presence of words on the label they did not understand. This was higher for agricultural respondents (66%) and consumers (60%).
- Respondents who did not speak English at home (55%) were more likely than English-speakers to volunteer that there were words they did not understand.
- Agricultural workers reported the highest rates for not understanding the hazard words listed on a label.
- The phrase 'wash out with copious amounts of water' generated the highest number of critical confusions and lowest comprehensibility. Critical confusions almost doubled for non-English speakers and "don't know" responses increased about 4.5 times.
- Understanding of the word 'prolonged' ranged from minutes (61% to 68%), to days or longer (14% to 17%).
- Understanding of the word 'repeated' ranged from once (23% to 32%), to more than 10 times (10% to 18%)

A wide range of terms (word and phrases) commonly used in hazard communication are either poorly understood, or have very variable interpretation. This is particularly the case with respondents who were not first language English speakers. Training should address both absolute meaning as well as variability in interpreting words that try to denote complex ideas. For example, the term "copious" as in "copious amounts of water", which stood out as particularly incomprehensible to respondents, yet could just as easily be rewritten in lay language as, for example, "lots of water."

Results identifying language difficulties were largely as anticipated, with worse performance from those respondents who were not first language English speakers. Not only did this affect hazard terms but it also contributed to the high variability of interpretations. Notably, respondents recommended both

simpler English on labels and SDSs and the inclusion of languages other than English (language most commonly on the hazard communication material).

- Respondents identified hazard statements present on an SDS fewer than 50% of times for all hazard statements, except those relating to protective clothing, eye irritation, storage in a cool, well-ventilated place and flammability. For the remaining 35 statements, correct identification did not exceed 50%.
- A small number of respondents reported health hazards that were not present for the chemical they were asked about.

Despite significant percentages of respondents indicating that health concerns underlay their choices of hazard ranking, or that hazard identification and health implications underlay their interpretation of symbols, the identification of health hazards was low. It seems that respondents had a general awareness of health issues but are not able to use hazard communication information to identify specific (health) information.

In this study, some respondents (who reported non-existent hazards) may have been over-reporting hazards. This may reflect either an interview bias (wanting to please the interviewer) or a sub-population of anxious respondents, concerned about their health.

7.8 *Colour

- Red was the colour most commonly reported (95%) as denoting highest hazard, irrespective of sector. Red was chosen by 82% of respondents, specifically because they believed it denoted hazard level.
- Yellow was usually ranked second (58%).
- Nine percent of respondents still indicated they would read the label because of their belief that, irrespective of colour, all chemicals are hazardous.
- Ranking preferences for hazard sequence showed two predominant colour sequences: red-yellow-green-blue and red-yellow-blue-green, almost equally distributed (about 30% each) and evenly distributed between sectors. The sequence used for pesticide labelling was reported by 30% of agricultural workers.
- Colour-blindness, present in approximately 12% of the sample) was increased in colour sequences other than these two commonest sequences.

Colour, which is not a central element of the GHS, other than in the layout of the symbols, does not appear to be very useful for denoting hazard, other than the use of red as denoting highest level of hazard, which was universally found. Hence, using red to denote hazard, where contextually appropriate, may be justified in light of these data on user interpretation of colour.

The sequence of colour was not reliably interpreted between individuals and sector. There was no real evidence that agricultural workers identified the colour sequence in any different pattern to industrial workers. A minority of agricultural workers provided a colour sequence that matched the colour ranking conventionally attached to pesticide hazards. Because colour sequence is important for agriculture, this demonstrates the need to do more work in this area.

7.9 *Use of SDS's

- Less than 60% of respondents used the SDS when answering questions on the SDS. Even when using the SDS, it was evident respondents did not spend time reading it, only paging through.
- Production workers were least likely to make use of the SDS when responding to questions on health hazards of a chemical.
- Responses to questions on hazard information on the SDS varied from 29% correct (mixing with water) to 93% (flammable). Patterns were similar across sectors.

- Correct or partly correct answers in response to 6 terms in the SDS were less than 40% except in relation to 'first aid' where correct or partly correct responses exceeded 70% for all sectors.
- If the ANSI standard criteria for symbol comprehension acceptability were applied to acceptability of hazard term comprehension, all 6 hazard terms (Table 6.19) and most of the responses to the 7 questions on chemical hazards (Table 6.18) would fail to achieve acceptable comprehensibility (less than 85% correct).

Use of SDS in practice was very poor. Despite the availability of an SDS, answers to questions for which information was present on the SDS were poor (Tables 6.18 and 6.19). This may reflect, on the one hand, a 'classroom' testing problem (in which performance reflects the testing context rather than real understanding), or may stem from failure to use the SDS. Many respondents simply answered the questions based on what they had previously seen on a label for the same chemical. For example, the flammable symbol, which was well recalled, probably prompted the correct answers to physical hazard, despite the fact that many respondents did not understand what a 'physical' hazard was. Alternatively, many respondents probably used general intuitive knowledge to generate an answer (e.g. Protective clothing would be indicated for most chemicals). The result was that comprehension on SDS items was reasonably good for 'obvious' things, but poor for the rest.

- Eighty percent of respondents indicated that SDS's were broadly intended for everyone working with chemicals.
- Yet usage of SDS's was low: 45% of respondents have never used an SDS and only 18% reported frequent use. Although usage was higher for industry and transport, at best (industry respondents), 26% made frequent use of SDSs and 49% never used an SDS.
- Laboratory / health care workers and supervisors / managers were more likely to have seen and used an SDS than production workers or safety representatives / shop stewards.

How is this contradiction explained? Firstly, the finding that SDSs were more likely to be used frequently by laboratory / health care personnel and supervisors/managers, could be seen as consistent with their work responsibilities. Transport respondents may also be more familiar with Trecards than SDSs. Some respondents saw the SDS as a repository for "all" information and may have seen the SDS as a kind of "bank" of information to be used as back-up. However, that also implies that although this bank of information is available, it may not be used at all by the same people who identify the SDS as being intended for everybody. It is as if a culture of non-use of SDSs exists but can be compatible with feeling secure that the SDS is 'there'. The research did not manage to tease out this problem.

For transport sector respondents, comprehensibility appeared reduced because of the lack of UN chemical numbers on the label, and inclusion of the UN number may serve to increase comprehensibility for this sector.

7.10 Training (short training)

- No statistical differences in comparing the comprehensibility of 4 hazard symbols, a signal word and a hazard statement were evident between those respondents receiving short training in module 10 and those not receiving such training.
- However, for all but one symbol (the chronic hazards symbol), comprehension in both groups was very high (of the order of 90% or higher)
- Trained respondents correctly identified the meaning of the chronic symbol more often than non-trained (about 1.5 to 2.5 more often), but this was not statistically significant.
- Compared to earlier answers on symbol comprehension, respondents who underwent training had far reduced critical confusions for the environmental hazard symbol.

The impact of a brief 'training' on comprehension is equivocal. However, as the survey was not set up to test the hypothesis, major shifts were not anticipated. However, what is clear is that even a brief targeted explanation provided to workers reduced the incidence of critical confusions substantially,

and for a “new” symbol such as for chronic effects, training can play a key role in improving comprehension.

It is likely that the simple process of interviewing participants shifted views about hazard communication, particularly when considering the difference between reasons for past use of labels and SDS compared to (stated) future reasons for their use, where hazard and health information were much more prominent. This probably reflects a learning effect in the course of the study.

7.11 Instrument

In terms of refining the comprehensibility instrument, some important lessons emerged. Module 5 will need to be reworked to accommodate the problem of respondents identifying the correct label based on the incorrect symbol (testing symbol comprehension based on asking respondents to choose a label carrying a particular hazard message). This was not picked up on piloting. Secondly, labels used in the toolkit could be further adapted by removing the batch number, which prompted some respondents to identify the label as an American label, rather than South African. Other minor changes to the sequencing and reducing repetition of the questions have been identified. However, the methodology has proven to be a robust one, and experience has been accumulated, which will be shared with others seeking to use the instrument.

7.12 Overview

In general, the study has shown that comprehension of hazard communication data varies widely. Important areas for focused interventions have been identified and are discussed below.