

**Interim Report:
Improving Quality and Efficiency of On-hill Data Collection**

Prepared for [redacted]

by

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October, 2009

Executive Summary

The Study

Our goal is to develop knowledge about the work environment of patrollers at [redacted] and their current work practices, as well as the kind of information that is collected, in order to offer informed recommendations about potential changes that can be made to standard operating procedures, formwork and information management technologies, maximizing guest safety and improving efficiency of operations using data. We have undertaken this work as part of our larger interest in improving data about the effectiveness of interventions administered prior to arrival in hospitals, which in turn is being undertaken in order to improve our scientific understanding of health outcomes associated with pre-hospital care. Findings reported here pertain only to operations at [redacted], which has graciously allowed us to observe first responders and speak to other staff members about data collection and management challenges related to collection of data about on-hill incidents.

In order to support better quality and continuity of care, we are committed, as researchers, to finding ways to make the work of first responders related to data collection and handling easier and more efficient. Keeping this in mind, we suggest pilot testing any changes and making changes to plans as necessary to ensure that any changes introduced truly do support staff in carrying out their work.

Findings

Data collected on the hill at [redacted] is gathered in a challenging environment, and must meet the varied needs of multiple stakeholders, including industry groups, care providers, and safety and risk managers at [redacted].

Currently, considerable variation exists in how key data such as name and date of incident are recorded across forms (both paper based forms and on-line forms), which leads to certain challenges and inefficiencies in managing and using data in varied settings.

We have identified short term / low barrier, medium term and long term changes which can be introduced to improve the quality and efficiency of on-hill data collection. Low barrier interventions focus on low cost and easy to implement changes aimed at standardizing key data fields across forms, in order to support matching of data across forms. Medium term interventions are interventions that will require either more time or more money to implement than low barrier interventions, and that carry with them a greater exposure to challenges during the implementation process.

Recommendations

Short term interventions:

- Standardize key data fields such as name, dates (of incident, date of birth, etc.) and location of incident across forms. One approach to this is the introduction of pre-printed *Rite in the Rain* notebooks.

- Introduce processes that both support staff innovation and yet ensure that new forms created follow standards.

Medium term interventions:

- Standardization of forms and procedures across mountains, and
- Review of PIPE applications for data structure consistency, and re-development of underlying databases.

Longer term interventions:

Develop a more robust data collection system through longer term planning of the [redacted] databases, and leverage existing use of cell phones to augment on-hill data collection.

Future Directions

We have secured resources which will allow us to continue working with [redacted] through the 2009-2010 winter season, and we are awaiting notification about additional funding which we have sought in order to expand the scope of our study to [redacted], BC Ambulance and others involved in collection and use of incident data.

We have also identified some funding programs which may be of interest to [redacted], that could provide additional labour to assist in modification of PIPE applications, and might provide the resources for some of the longer term interventions we have identified.

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Acknowledgements

We are grateful to have had the opportunity to work with numerous staff members at [redacted] who have generously allowed us to observe them while they do their work. It has been a pleasure to conduct research in such a unique and special setting.

Thanks to the many bike park patrollers who voluntarily participated in this study and provided valuable insight into their daily work routines, as well as the staff members who spoke with us at the end of the 2008-2009 ski season, and others who have spoken to us at length about aspects of data collection which occur at [redacted] which are not reported at in depth here.

Thanks also to Brian Leighton for taking the time to meet with us to get this study going, safety supervisor Peter Jean, and Kira Cailles, patrol supervisor in the bike park for sharing their experience and expertise.

[Redacted] and its dedicated staff are clearly committed to optimizing data collection procedures related to patient care, and we look forward to working with [redacted] to create a system that will ensure that the most complete and relevant information is captured in relation to on-hill incidents.

Introduction

The project whose preliminary results are reported here is concerned with examining how the quality and continuity of patient care information can be improved in the pre-hospital care trajectory, by ensuring that information collected at different points in the pre-hospital care chain is transmitted to subsequent care providers efficiently and effectively, and in a way that supports the needs of diverse stakeholders. As a starting point in this process, we have been focusing on identifying opportunities for more efficient collection, handling and management of incident information collected on the hill.

The benefits of our work will include identification of opportunities to improve service to guests through enhanced data collection and analysis, reduction of exposure to risk, improved knowledge of optimum patient care strategies, and improved patient care. A well-structured system for capturing information throughout the trajectory of an incident makes it possible to trace individual incidents and explore larger trends, which in turn supports risk reduction and state-of-the-art on-hill care. A well designed system should support staff in their data collection efforts, capture information needed by multiple information users (e.g., health providers, corporate users), and fit easily into staff's existing work routines.

Our SFU-based research team has been conducting fieldwork about on-hill data collection since April, 2009. After a brief period of observations in the [redacted] alpine and bump rooms in April, 2009, during which time we developed a rudimentary knowledge of [redacted] alpine operations, we began to focus our observations on [redacted] Bike Park operations and data in early June, 2009, with the goal of observing how incident data is collected in the bike park, and how it is transferred and managed.

After learning about the challenges of managing WorkSafe claims, we also spent some time learning about WorkSafe reporting as well as other safety reporting, in addition to learning about summer bike park and summer alpine operations. This report will deal primarily with our observations related to summer operations, as we have spent a more significant amount of time shadowing patrollers in the bike park and alpine during the summer than during the winter season. However, the material here also reflects our increasing knowledge of full operations, as many of the patrollers working during the summer also work during winter operations, and have been able to provide insight into their work practice in both contexts. We anticipate that our awareness of the daily challenges faced by [redacted] patrollers during the winter will grow as we conduct fieldwork during the upcoming winter season about [redacted] operations, which will enrich our understanding of the issues associated with working with incident data in a full spectrum of wilderness conditions.

This report contains some initial ideas and recommendations concerning [redacted]'s data collection procedures and infrastructure, based on our fieldwork and research up to this point, and will serve as a jumping-off point for discussion about future directions for this project. In this interim report, we will address both changes that can be made in the short-term to existing data collection and management protocols with what we hope will be little disruption to existing routines and practices, as well as additional interventions that might be adopted in the longer term in a more extensive and fundamental redesign of how key information is collected and accessed.

Description of Environment

[Redacted] is a mountain resort that consists of two mountains, which include more than 8171 acres of lift-serviced terrain for skiing and snowboarding in the winter months, and lift-serviced hiking and mountain biking during the summer months. Sight-seers frequent both mountains throughout the year as well, and tour operators (e.g., ATV and horse back riding tours in the summer, and snowmobile tours in the winter) also operate on the mountains.

Initially begun as two separate businesses, the mountains have shared a common base since the early 1980s and became a single corporation in 1997. With the opening of the [redacted] gondola, staff can more easily move between the mountains, which in turn has made it easier for the two mountains—run somewhat separately in the past—to be managed as a single entity. The [redacted] gondola has provided a stronger impetus for integrating the operations of the two mountains than has previously existed.

On-hill Data Collection

Currently, the forms in use at [redacted] generally collect information about a single aspect of an incident. However, from our observations it became clear that many of these forms play a dual role and are used to both assist staff in responding to and organizing events, and at the same time the forms seek to capture information about those events. This information is subsequently reported to numerous internal departments and external agencies, and the specific agencies and bodies that need to be involved differ in relation to the nature of events. Incidents often have many interacting facets that necessitate the involvement of multiple organizations and multiple forms. For example, a serious injury

involving both an employee and a guest in the bike park may require the completion of both bike park incident forms and WorkSafe forms, in addition to statement forms in the case of possible liability. The important thing to highlight here is that ultimately, there should be some way to link all forms that relate to a specific incident in order to capture a more complete picture of what occurred, especially in cases where legal proceedings are involved.

As we became familiar with [redacted] operations, we learned that in-house forms are designed such that a single form is used to collect information about a single aspect of an incident, and that in many cases there may be a need to record information collected on one form on another form (because data are often captured which must be reported to external agencies, each with their own forms), or to link two forms that relate to the same incident (e.g., the WorkSafe 7A form is intended to record details that relate to the injury of an employee in the course of his or her duty, and if the employee is injured on the hill (e.g., a guest skis into an instructor), information collected on another form (e.g., the Canada West Ski Area Association form completed for the injured guest) may also be pertinent to the incident. With each day we spend with mountain employees, our appreciation of the complexity of the [redacted] operation grew, and we came to learn that recording information in such an environment is seldom a matter of filling out a single form that will be used for only one purpose.

Issues and Challenges

[Redacted] is a large, complex organization which has a relatively junior labour force with frequent turnover in many positions, as well as many long term staff members with a significant commitment to the organization, and an investment in how things are done. Historically, the two mountains operated separately, one consequence of which is that in some cases procedures have differed between [redacted], and consequently, forms vary between hills. Additionally, as [redacted] has grown, so too have operational areas. Procedures have evolved as new operational areas (such as the bike park) have developed, and with the growth of these new areas, new forms have been required.

[redacted] interacts with numerous other agencies in carrying out day to day operations, and in relation to incidents. These include industry associations such as the CanWest Ski Areas Association, and a range of other agencies such as WorkSafe BC, insurance companies, and provincial agencies such as the Public Safety Office. Hence, on-hill data collection must meet both internal needs (e.g., related to incident management and reporting data to senior leadership), and at the same time data collected must also responds to the informational needs of these extra-local stakeholders such as WorkSafe BC, many of whom have their own computer systems (e.g., WorkSafe) and require electronic data entry.

Assessment of Situation

Our preliminary observations suggest that operational and health research needs can both be better served by improving standardization of key information (e.g., name of subject, date of incident, name of responder(s)) collected about subjects across forms. Additionally, standardization of procedures and forms between mountains is likely to yield operational efficiencies, and it may be possible to achieve additional efficiencies by reducing duplication of information collected across forms. This interim report addresses the first of these three issues (standardization of information across forms), and includes only

preliminary comments about standardization of practices between [redacted] and [redacted] and overlap of forms (reflecting the limited time we have spent learning about some aspects of the operation thus far). It should be noted as well that standardization of practice in the context of [redacted] operations will involve reconciling the two very different organizational cultures that still exist, remnants of the time when the two mountains were still separately owned and operated.

Interventions

Our data collection suggests that a wide range of interventions are possible, that can be roughly grouped in terms of the ease with which they can be implemented. Below, we outline low barrier, medium barrier and higher investment interventions. Low barrier interventions are those which can be implemented with minimal cost within a relatively short period of time, and which we do not think will substantially change how staff do their jobs (work practices). Medium barrier interventions may require either increased buy-in on the part of staff because they may more substantially alter existing work practices, or may require increased investment to implement. Finally, higher investment options represent a fundamental redesign of current methods, and will require the investment of resources in retraining of staff, redevelopment of key standard operating protocols as well as physical information-gathering infrastructure. Each class of recommendation is described briefly below.

Low Barrier Interventions

Low-barrier interventions can be implemented in the short term, with minimal cost and minimal change to existing work practices. Initial low-barrier reforms in information collection materials and procedures are simple measures designed to increase buy-in on the part of the employees with regards to becoming active participants in the change. Reforms can only succeed if the individuals on the front line, collecting the data, support the new initiatives, and showing how collected data can become more accessible and more useful with a few small changes may help to increase tolerance for changes that impact entrenched work routines more dramatically.

Standardization of Critical Data Fields Across Forms

Standardizing the format of critical pieces of information such as name and date across forms can make it easier to trace an individual when multiple forms are used to document different aspects of an event or incident. In examining the forms most commonly used by [redacted] in its summer operations, the most overlap in information across forms is seen in fields containing personal details describing the subject of the incident. On forms in frequent use during bike park and other summer operations, the structure of these fields is often not specified, and if the structure is specified, it is not specified the same way across all forms. Thus, a 'John Smith' recorded on one form may be listed elsewhere as 'Smith, Johnny A.'

Many fields are 'open' fields, where the individual filling out the report enters free text, resulting in variability in how data are recorded on a single form, which can make it difficult to link to other forms pertaining to the same incident. For example, the date-of-birth field on the bike park incident form is open, making it possible to record the date in any number of different ways (e.g., June 10, 2009,

10/6/09; 10/6/2009, 6/10/09, 6/10/2009, 10 June 09, etc.), whereas the date field on the WorkSafe form has a specified structure (month/day/year). In the event that the individual filling out the bike park form uses a different convention than what has been used on the WorkSafe form, it becomes difficult to link these two forms using the date as a reference point in the event that an incident involved an injury to a guest in the bike park also contributed to injury of an on-duty staff member.

In order to make it easier to search for documents and link related documents, it makes sense to ensure that standardized formats are adopted for several key fields (at least three) in order to reliably confirm that several different forms are tied to the same incident, involving the same subject. Standardization of certain key fields will make it much easier to trace individuals through the system in the case of follow-up queries about the circumstances and resolution of a past incident. 'Triangulation' (matching 3 data points, such as name, date and date of birth) with key fields can only work if that information is both present across all forms and listed in a standard format across all forms.

Overall Goals for Standardization:

A certain field should be structured the same way across all in-house forms. It doesn't matter so much what that structure is, so long as it is consistent. Where possible, complex fields should be broken down into sub-fields so that component parts of addresses and dates can be re-ordered to comply with the data needs of external organizations. (This will become a more significant issue as increasingly additional organizations require on-line data entry). Of course, this re-ordering will only be possible if data is converted into an electronic form at some point along the line, and not merely archived as hard-copy or scanned in as a picture file (which limits its use without further processing in databases).

General principles:

- attempt to get staff away from free text entry formats for names and dates;
- use the same name and date format across all forms;
- reinforce the name and date format in use on forms by providing a printed example of the desired format on the printed forms;
- reinforce the name and date format in use on forms by carrying the same format over to all computer applications accessible through the PIPE.

Standardization of Subject Name

We have encountered three different variations of this field across twenty-four different forms we have reviewed to date that contain a field for subject's name (please refer to Table I in the appendix).

- Twenty-one forms have totally unstructured, open fields;
- Two forms ask for names structured as last name/first name/middle initial;
- One form asks for names structured as given name/ initial.

Recommendations

In the case of the subject field, in-house forms that are currently unstructured should be standardized to have names collected as three sub-fields (first name, middle initial and last name). Using this approach,

these separated sub-fields can be recombined in any possible order when it comes to reporting out to external bodies each of which may use different conventions. In terms of the order of these sub-fields as they are displayed on the form itself, first name should be first, followed by middle initial and finally last name. We are suggesting this order because in a crisis situation, a first responder will commonly ask for a patient's first name at the outset, before soliciting any additional information such as last name, and it is important to maintain the flow of a crisis interaction.

Standardization of Incident Date

We have encountered three different variations of this field across twenty-four different forms we have reviewed to date that contain this field (please refer to Table II in the appendix).

- Sixteen forms have totally unstructured, open fields.
- Six forms indicate that date should be recorded month/day/year.
- Two forms indicate that date should be recorded day/month/year.

Recommendations

Again, incident date should be recorded as a set of linked sub-fields (month, day and year), which can be reshuffled as needed when reporting out to an external organization with particular requirements for the structure of the date field. Of course, it makes sense to standardize the structure of this field across [redacted] forms, and judging by the fact that all in-house forms that are already structured have gone with the month/day/year format, it makes sense to continue that trend.

Standardization of Date-of-Birth (DOB)

We have encountered three different variations of this field across twenty-four different forms we have reviewed that contain the date-of-birth field (please refer to Table III in the appendix).

- Nineteen forms have totally unstructured, open fields.
- Three forms indicate that DOB should be recorded month/day/year.
- Two forms indicate that DOB should be recorded day/month/year.

Recommendations

Date-of-birth should be recorded as a set of linked sub-fields (month, day and year). If the convention used by on-line forms that currently specify structure in this field is continued (e.g., the WCB 7A on the Safety Application), in-house forms should be standardized to conform to the format month/day/year.

In order to reinforce a consistent date format across all forms, a review of applications within the PIPE should also be undertaken at some point in the future, to ensure that on-line applications use a data format that is consistent with date formats used on forms., and any subsequent programming of applications accessible through the PIPE should make it possible to re-order components of data fields (e.g., produce a report that lists data by day / month / year or month / day / year) to support ease of reporting to external agencies (this is addressed in greater detail below).

Potential Issues and Challenges with Standardization

It becomes apparent in comparing [redacted]'s in-house forms with forms used by external agencies (e.g., the National Ski Area Accident Report) that there can be some significant differences in how the same piece of information is recorded on different documents. This is a clear issue, in that the [redacted] patrol (an agency under private management) interacts with (or in data terms, is coupled to) essential services run by other entities (e.g., EHS). Of course, when it comes to standardizing the structure of data fields, [redacted] only has direct control over its own internal forms, which may present a problem when the corporation needs to report out to several other organizations which may require data in different formats (hence the comment in the previous paragraph about data capture through PIPE applications—capturing data such as dates in a format that supports re-configuration will make it easier to produce data in whatever format is required by external agencies as those agencies and [redacted] increasingly utilize on-line reporting).

Ultimately, the way to address this may be to move from a data collection and archiving system that is largely paper-based, to a system that is electronic in nature, and thus inherently more flexible. By collecting information electronically, it may be possible to produce reports in the format required by other agencies while still maintaining in-house records that conform to company needs. This is a longer term undertaking addressed in greater detail in a subsequent section of this report. In the short term, some standardization of data collection can be introduced to the current paper based (and computer supported) data collection systems in place (e.g., through form re-design of forms and potentially pre-printed *Rite in the Rain* notebooks, addressed below). Additionally, it may be possible to improve efficiency of working with data by undertaking a review of online forms and underlying programs which are currently used by [redacted] staff, and are accessed through the PIPE (addressed in medium term interventions, below).

Elimination of Old Forms

There are some cases where older forms may still be in files and could be used in error, and the process of winnowing out and removing older forms should continue to be undertaken regularly (e.g., seasonally).

Re-Design of Forms and Creation of New Forms

We learned that often modifications to existing forms are made or new forms are created as a result of staff initiatives, when it becomes clear that existing forms either can be improved or new operational areas (e.g., the bike park) emerge and new collection of data is required. Some excellent forms have been created as a result of such initiatives (e.g., the bike park form), which suggests that supporting staff to undertake form modification and development are important. At the same time, it may also be a good idea to develop a policy that would encourage or require employees to notify their supervisors if they are planning to create a new form to document a new aspect of their work or to facilitate their work, so that planned forms can be integrated into existing work procedures in a way that does not introduce new or additional inconsistencies into data collection processes, and does not introduce unnecessary redundancies.

Pre-printed Rite in the Rain Notebooks

Perhaps one of the most effective options to try would be offering patrollers *Rite-in-the-Rain* all-weather notebooks pre-printed with the fields that comprise the bike park incident form, and the National Ski Area Accident Report. As things now stand, recording patient information from a single incident is a three-part process in the bike park. A first responder will often take down guest details in his or her blank notebook while a response effort is in progress, later copying that information onto a hard-copy bike park incident report form, and then, further, entering the information from the incident report form into an online incident form accessed through the PIPE. Essentially, the same work is being done multiple times, and the possibility for data loss and/or error exists each time the data are transferred to a new paper-based or computer-based input form.

Introducing a pre-printed notebook can contribute to standardization of what data are collected about incidents, and can support standardization of the format of the data. It is possible that subsequently the pre-printed *Rite in the Rain* forms could be scanned and data entered directly into programs currently accessed through the PIPE which could eliminate one of the data entry steps (entry in both a *Rite in the Rain* and the bike park incident form) in the short term. In the absence of forms that could be scanned, first responders would still need to enter data manually into the online form via the PIPE (or, in the case of winter operations, the data would need to be entered on their behalf), but the use of pre-printed *Rite in the Rain* notebooks could eliminate the need to fill out a hard-copy form after writing down unstructured notes in a *Rite in the Rain*. Further, making a scanner available (in the Children's Learning Centre during summer operations, and in Alpine bump rooms during winter operations) to create an electronic copy of the handwritten patient care notes might improve the quality and accessibility of incident data. It should be noted though that whether or not scannable forms would increase data quality will depend upon whether or not a scanner works as promised and issues related to how information is entered into PIPE applications (including a redundancy system that checks for data completion and insures that data are scanned) are adequately addressed. The obvious benefit of scannable forms is that an electronic record of forms would be created immediately and with minimal effort. Although it may still be necessary to file and store a hard copy incident form, data from the forms would be accessible to multiple staff members through the PIPE, as required (e.g., safety and risk staff could both access the same report at the same time online). Additionally, pre-printed notebooks would encourage completeness in filling out incident reports, and we hope would lead to improvements in the quality and completeness of data gathered by first responders. Reflecting the challenging circumstances under which patrollers are carrying out their work, bike park incident forms are seldom exhaustively filled out, as some fields may not be applicable to a given incident, or in the chaos of responding to an event, a patroller has simply forgotten to solicit a particular piece of information from his or her patient. We are hopeful that under such circumstances, the pre-printed *Rite in the Rain* notebooks would act to prompt the patroller to ask certain questions.

Potential Limitations and Issues

It should be noted that not all bike patrollers use *Rite in the Rains*—some record information directly onto the bike park incident forms, and hence any practice put into place would have to accommodate

those using both forms and *Rite in the Rains*. From what we have observed thus far, completion of forms at the scene of an incident is much less common during winter operations, where data are more typically entered into *Rite in the Rain* notebooks at the scene and transferred onto forms as required in the bump rooms.

Finally, it is important to note that current practices have a built in redundancy. For example, during summer operations, forms that have been filled out are left in a pile to the left of the computer in the CLC bump, where a check mark is placed on them once they are complete and data have been entered into the PIPE application. Use of pre-printed *Rite in the Rains* would make it more difficult to determine if incident reports have been entered into the PIPE application (unless loose paged *Rite in the Rains* are used). Hence a system will need to be devised to insure that all incident forms from a pre-printed *Rite in the Rain* are further processed (e.g., scanned or entered into the PIPE application).

Suggested Implementation Strategy

Use of *Rite in the Rains* is more widespread during winter operations than summer, and hence it may be appropriate to undertake a pilot of a pre-printed *Rite in the Rain* during winter operations.

Prior to printing a large run of custom *Rite-in-the-Rains*, in order to ascertain that this strategy will, in fact, improve the quality of data collected on the hill, we would advise first developing a mock-up that can be reviewed by an assorted group of patrollers prior to the start of the season (some known for excellent documentation, some known for poor documentation and some in the 'average' group). The mock-up should be reviewed by patrollers prior to even a limited production run, and feedback gleaned from that review process should be used to revise the initial design. A small run of this refined design could then be piloted during the 2009/2010 season by a small group of patrollers to ensure the usability of the preprinted *Rite in the Rains* before a wider-spread introduction of pre-printed *Rite-in-the-Rains* is introduced. A small scale pilot would also make it possible to develop strategies for processing of data from the pre-printed *Rite-in-the-Rains* that work from a staff standpoint. Because of the need to maintain redundancy that insures data are complete and further entered into PIPE applications as required, pre-printed *Rite in the Rain* loose pages could be tried in the short term, as they could be used in a manner that is consistent with existing means of checking for data completeness.

Medium Term Interventions

Medium term interventions are those interventions that will require either more time or more money to implement than low barrier interventions, and that carry with them a greater exposure to challenges during the implementation process.

From our preliminary work thus far, two medium term interventions hold promise:

- Standardization of forms and procedures across mountains, and
- Review of PIPE applications for data structure consistency, and re-development of underlying databases.

Each is addressed below in further detail.

Standardization of Forms and Procedures Across Mountains

Duplicates of forms still linger from the days when [redacted] and [redacted] were run separately. For example, in the case of recording information related to an incident involving aerial rescue, there appear to be two different forms that fill the same role, one from [redacted] (the “Code H – Helivac/HETS Form”) and one from [redacted] (the “Medical Evacuation Dispatch Form”). Another case of duplication is evident in the dispatch forms used. In seeking to create a single form for use across [redacted] as a whole, however, those involved in the redesign should keep in mind issues of organizational culture. It is understood and articulated by patrollers themselves that there are distinct differences in practice and ethos when it comes to patient care on the two mountains. These differences are crystallized and made manifest in the structure of the forms themselves. For example, patrollers have commented that [redacted] has historically hired more paramedics to work as patrollers on the hill, and have noted that [redacted]’s forms often tend to resemble EHS forms in terms of the comprehensiveness of information solicited. The challenge is to create a common form that accommodates the needs of patrollers from both mountains to the greatest extent possible, and, in the event that a single set of operating procedures is introduced across both mountains, reflects that process.

We have not yet been able to spend enough time observing winter operations to be in a position to recommend specific changes that could result in the same practices and forms on both mountains, but hope to be in a position to make such recommendations by next May. Because of the strong views about and loyalties to mountain-based procedures, we view the process of re-designing forms (which is really reflective of re-designing practices) as a medium term intervention.

Recommended Strategy for Moving Forward

Our approach to studying work is one which begins with the view that if work is being carried out in a particular way, there is probably a reason it is carried out that way. Hence, our job becomes one of learning about what the underlying reasons are that work is organized and carried out in particular ways.

Given the passion with which patrollers on both mountains are committed to the practices in use on ‘their’ mountains, any efforts to alter those practices should be undertaken in a manner that acknowledges the historic reasons for carrying out work in a particular way, and at the same time seeks to develop a common practice across mountains that reflects a ‘best of breed’ approach (the best way a particular set of tasks is carried out).

One strategy for moving forward with developing forms and procedures common to both mountains follows:

- Working from forms, identify areas where two different forms (and hence procedures) likely exist between mountains;
- Identify further differences as a result of observing how work is performed on both mountains;
- Target those areas where practices differ for in-depth observation during winter operations;
- Use the in-depth observations to complete work practice maps of current procedures that differ between mountains;

- Develop a report which identifies the underlying reasons that practices differ, and highlights the strengths of each approach;
- Share that information with staff from both mountains and seek their input about altering practices to a model that is shared between mountains, which builds on the strengths of practices carried out on both mountains);
- Subsequently, engage in form re-design to reflect new shared practices, and pilot test forms and procedures before introducing widely, leaving time for iterative change based on feedback from initial pilot testing.

Review of PIPE applications for data structure consistency, and re-development of underlying databases

Challenges associated with changes in the WorkSafe reporting practices, instigated by WorkSafe over this past summer, highlight the need to maintain data systems that are flexible enough to accommodate changes in external reporting systems, and also support required in-house reporting that sustains ongoing operations.

In our work to date, we have only incidentally learned about the PIPE, and hence our comments here reflect only a limited understanding of the [redacted] computing environment.

From our interactions with employees, we have gathered that the PIPE is an interface to the [redacted] computer system that is a 'go to' place for access to forms that are frequently used to carry out operations. Examples of forms accessible through the PIPE include blank copies of all forms used in ongoing operations, as well as data input forms that record data about events such as on-hill incidents (both bike park and skiing/snowboarding), WorkSafe investigations and other incidents.

It appears that data input forms have been added as required, and only limited integration of data collected across forms exists. Sharing of data between applications in the PIPE appears to be limited, which can contribute to challenges associated with locating information across multiple forms which all pertain to a single incident, such as an on-hill injury. Our recommendation above to standardize key data points across forms should make it easier to identify multiple records which relate to a single individual or event. A further step, though, would be to alter the way in which the data is captured within PIPE applications, so that information can be more easily shared between forms, and can be more easily linked and the format of information can be altered as required for reporting purposes. We know little at this point about the structure of databases which capture information collected through forms available on the PIPE. It appears, however, that there is only a limited ability to alter the ways in which reports can be generated, which has presented some challenges over this last summer with respect to WorkSafe forms in particular. While a full review of PIPE applications and re-design of data entry forms used to capture information is a longer term undertaking (see below), there may be some benefit in the shorter term to conducting a review of data capture mechanisms in use currently which are accessible through the PIPE. Such an exercise would result in a list of potentially easy to remedy alterations (e.g., standardization of name, DOB and date information across applications) which may make it easier to locate existing information within PIPE applications. It may also be possible to secure low cost labour through grant fundraising to support such activities.

Longer Term Interventions

Leveraging Existing Cellphone Infrastructure

Beyond the initial measures we have discussed that we hope will serve to improve existing paper and computer based collection of incident data, there are opportunities to pursue more fundamental changes in the longer term in how data are collected and worked with.

Moving beyond a pen-and-paper approach, data collection using a cellphone platform may be the next logical step (particularly if we can access technology as part of a research endeavor, addressed at greater length below). As most patrollers and other staff already carry a cellphone, and cellphones have assumed an important role in both safety operations and in notification of senior staff about incidents, creating a data collection application that runs on a phone would extend and build on existing practices, and would in most cases not add to the gear or increase cognitive load an undue amount by forcing staff to learn to use an unfamiliar device. The latter point is important – in a stressful work environment characterized by time and resource constraints, and it is important that technology not be a focal point. Successfully integrated technological aids should not draw attention away from the patient or crisis management process at hand.

Additionally, cellphones are compact, and newer phones offer several capabilities such as time and location stamping (if GPS equipped) that could be useful in terms of creating precise records, especially when those records are often referred to in the case of legal proceedings. At the level of cost effectiveness, the existing cell phone platform seems to work well, and future activities could build on an existing relationship between [redacted] and Telus (who have an interest in health applications). With a strong cell phone infrastructure in place, no further investment in large-scale communications infrastructure would be required to support increased use of cell phones for first-responder data entry. A carefully structured partnership (e.g., where Telus provides airtime in exchange for tower location or advertising its support of [redacted] operations) and phone devices are purchased in bulk or obtained through another partnership mechanism, or initially through research) could result in a relatively low-cost means of streamlining on-site data collection.

Entering patient data directly into a handset like a smartphone could potentially streamline existing processes like dispatch notification that currently occur over the radio. As things now stand, patrollers communicate patient name, age and the nature of injury to the dispatcher on call, who then records that information manually on the hard-copy dispatch radio log. If this information were entered by the first responder directly into a handheld application, it could theoretically directly populate a corresponding electronic dispatch log form. This would minimize any copy errors due to the poor audio quality of the radio, and free up the radio channel for other communications.

As well, we have observed that often patrollers can be so busy providing care and expediting the transport of patients from the hill to the clinic, that they have little time to record key information. The voice-recording capacity offered by many cellphones represents another option that could support improved data collection at the scene of incidents, and could allow patrollers to make quick voice memos as they provide care and collect information such as vitals, without having to sit with a pen and

paper to write it down, or even spend time entering it manually into the phone. These memos could be converted to text at a later point, when the patroller has time to review the incident.

However, despite the fact that a cellphone could support many of the data handling aspects of patrol work, we feel it is important to preserve the radio as an open channel, enabling patrollers to monitor the mountain environment and the activities of their co-workers in a passive fashion. The radio fills an essential niche in that it allows all patrollers to maintain a common basis/source of information for discussion and planning around critical incidents, and also acts as a background resource that helps patrollers anticipate where they may need to be in order to assist.

Future Directions

In our preliminary observations, we have come to understand [redacted] as a complex data environment, in which data are collected and subsequently used in communications with diverse internal users as well as agencies outside of [redacted]. On the one hand, some data issues pertain mostly to [redacted] practices (e.g., standardization of fields across internal forms currently in use on both mountains). Additionally, there are issues related to how information is communicated to external agencies (such as WorkSafe BC or the public safety office). This last summer, new challenges cropped up when WorkSafe procedures changed, which had significant implications both for how data are input by [redacted], and for the availability of information for internal purposes.

A review of current database structure undertaken in relation to a bigger picture view of reporting requirements (e.g., the need to report to multiple bodies ranging from Intrawest management to the Canada West Ski Areas Association, WorkSafe and other insurers) could be undertaken as a first step in re-designing the underlying database structure in use.