## THE SUN AND YOUR HEALTH: TARGETING TEENAGERS AND ADOLESCENTS IN BRITISH COLUMBIA

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Roughly, 85% of skin cancer cases could be avoided by reducing ultraviolet (UV) exposure, especially during adolescence. We conducted a pilot study to evaluate sun safety behaviors in this age group, as well as, the effects of an innovative intervention. Participants were recruited from 8 secondary school classes in Vancouver, BC. Participants were segregated into either the control arm (N=38) or intervention arm (N=138). All participants engaged in a 15-minute teaching session. The intervention group also had UV facial photographs taken to reveal UV related damage. To assess baseline attitudes/behaviours and the impact of the intervention, a survey was administered prior to the study, immediately afterwards and at 6 months after the study. Education alone and in combination with the intervention significantly improved knowledge immediately afterwards and at 6 months. Both groups showed a significant decrease in individuals who thought that the appearance of a tan was a positive quality. With regards to sun safe behaviours, the intervention group showed a statistically significant intention to change with regards to all behaviours assessed (use of a hat, protective clothing, sunglasses, sunscreen and seeking shade). Only the intention to use sunscreen significantly improved in the education only group. The intervention group showed a lasting change in behaviour at 6 months with regards to wearing protective clothing, sunglasses, sunscreen and seeking shade. The educational session alone only changed behavior with regards to the use of sunscreen. Additionally, only the intervention group experienced a decrease in the number of sunburns during the following summer.

Category: 2 Early experiments with well defined objectives/hypotheses

#### NONINVASIVE SKIN CANCER DIAGNOSIS BY RAMAN SPECTROSCOPY

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**Background:** Raman spectroscopy is a non-invasive optical technique that provides finger-print information on molecules within biological tissue. We developed a real-time Raman system for clinical skin cancer diagnosis that provides analysis results in less than 2 seconds. A previous large-scale clinical study established that real-time Raman spectroscopy can distinguish malignant from benign skin lesions. The objective of this presentation is to provide an update of this technology for skin cancer diagnosis, particularly the results of the newly proposed wavenumber selection algorithm. *Methods*: An integrated real-time Raman spectroscopic system was used to acquire skin Raman spectrum. The spectra were divided into training (n=518) and test set (n=127). Wavenumber selection was implemented using windows of wavenumbers and leave-oneout cross-validated stepwise regression. Multi-variant statistical analysis was used for lesion classification based on selected wavenumbers. Results: Diagnostic performance was improved for the training set, the test set and the combined dataset after wavenumber selection. The area under the receiver operating characteristic curve (ROC AUC) with 95% confidence interval (95%CI) was improved from 0.879 (0.829–0.929) to 0.905 (0.879-0.931), from 0.861 (0.796-0.927) to 0.891 (0.835-0.948), and from 0.891 (0.867-0.948)0.916) to 0.906 (0.883–0.929) for the training, the test and the combined set, respectively. The overall diagnostic specificity was improved from 0.17–0.65 to 0.20–0.75 at sensitivity levels of 0.90–0.99. *Conclusions:* The overall diagnostic accuracy for skin cancer detection was improved by about 10% when wavenumber selection algorithm was incorporated in Raman Spectroscopy analysis.

**Category:** Applied/functional experiments

## DISTINCTION OF CONDYLOMATA ACUMINATA FROM VULVAR VESTIBULAR PAPULES OR PEARLY PENILE PAPULES USING Ki-67 IMMUNOSTAINING

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Ki-67 is an immunohistochemical stain used as a nuclear proliferation marker. It is non-specific, and is expressed in all active phases of the cell cycle. Vulvar vestibular papules in women and pearly penile papules in men are benign fibrous papules on the genitals, are non-infectious, and do not require treatment. However, these lesions can be clinically confused with condylomata acuminata induced by human papillomavirus (HPV), which have medical and social implications. Since HPV infection is known to induce expression of proliferation markers, we propose that Ki-67 may be used to differentiate condylomata acuminata from vulvar vestibular papules or pearly penile papules on pathologic examination.

### **Category**:

(2) Early experiments with well defined objectives/hypotheses

# EFFECTS OF VISUALIZATION OF PRE-OPERATIVE DEFECTS ON PATIENT SATISFACTION AFTER FACIAL RECONSTRUCTION FOR SKIN CANCER RESECTION: A RANDOMIZED CLINICAL TRIAL.

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Purpose: Patient satisfaction after reconstruction of surgical defects is an important surgical outcome measure. This study will address patient satisfaction after reconstruction of Mohs skin cancer resection defects on the face with patients either visualizing or not-visualizing their defect. Effects on patient satisfaction will be assessed on the day of surgery and over time. Objective: To determine the effect of direct visualization of the Mohs micrographic surgery pre-operative defects on patient satisfaction after facial reconstruction. Methods: This study is a randomized clinical trial involving patients undergoing Mohs surgery. Patients are randomized into to either viewing or not-viewing their defect prior to reconstruction. Both groups are provided a series of surveys to assess their post-reconstruction satisfaction at multiple points in time. Analysis: The patient satisfaction variables and skin-related quality of life measures are compared between the experimental and the control group.

#### Category

Early experiments with well-defined objectives/hypotheses

## THE USE OF CHROMATOGRAPHIC FINGERPRINT ANALYSIS IN THE IDENTIFICATION OF CULPRIT ALLERGENS FOR ALLERGIC CONTACT DERMATITIS

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As a result of the ethnic diversity in our communities and differing medicinal practices, dermatologists are increasingly seeing patients who use complementary and alternative medicine. These medicines possess both physiologic and pathologic side effects with the most common adverse event reported as contact dermatitis from topically applied treatments. The identification of a clinically relevant allergen is difficult because the identity of individual chemical constituents in these products are not easily ascertained. We provide an approach to culprit allergen identification for patients who react to complementary and alternative medicines without ingredient lists, illustrated by a 50-year-old female who developed a severe allergic contact dermatitis to a topical traditional Chinese medicine. A PubMed search was conducted using the following search terms: allergic contact dermatitis and traditional Chinese medicine.

The identification of the cross reacting chemicals was achieved through the use of a readily available chromatographic fingerprint analysis reference. Although 13 positive patch test reactions occurred, a clinically relevant correlation was found between 6 patch test allergens and their corresponding traditional Chinese medicine ingredients using our process. Allergen identification can be challenging for allergic contact dermatitis to complementary and alternative medicines, but identification is possible through the use of a chromatographic fingerprint analysis reference.

Category: Pilot/exploratory experiments

# METHYLISOTHIAZOLINONE CONTACT ALLERGY PREVALENCE IN WESTERN CANADA: INCREASED DETECTION WITH 2000 PPM PATCH TEST ALLERGEN

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**Background:** Contact allergy to methylisothiazolinone (MI) or the combination of methylchloroisothiazolinone and MI (MCI/MI) is a worldwide, increasing cause of allergic contact dermatitis, with prevalence rates higher than 10% in some centres. **Objectives:** The objective of this retrospective chart review is to provide a Western Canadian perspective on the positive patch testing rate to MCI/MI or MI during the testing period of 2008 - 2017, and to determine if addition of MI at 2000 ppm resulted in increased detection. Methods: We conducted a retrospective chart review of patients who tested positive (n = 137), of 2576 total patients who were patch tested for MCI/MI and MI at a community dermatology clinic in Vancouver from January 2008 – April 2015, and Nov 2016 – Dec 2017. Results: Positive results for MCI/MI and/or MI increased until 2015, at 15.29%. The 2016-2017 data showed a decline to 8.27%. When testing for MI at 2000 ppm was introduced in 2013, the initial positive patch testing prevalence was 6.6%, followed by 10.1% in 2014, 12.9% in 2015, and 4.26% in 2017. Conclusions: We demonstrate an increasing prevalence of MCI/MI and MI allergy between 2008 – 2015, followed by decline in 2016 – 2017. Future years of clinic data will help determine whether the decline is durable, and perhaps due to decreased consumer exposure following tightened Health Canada regulations since 2016. The addition of MI 2000 ppm increased the positive patch testing yield for MI. Our results support the importance of continued patch testing for and regulation of these preservatives.

Category: (2) Early experiments with well defined objectives/hypotheses

# AUTOMATED ANALYSIS OF VASCULAR STRUCTURES OF SKIN LESIONS: SEGMENTATION, QUANTITATIVE ASSESSMENT, PATTERN RECOGNITION, COMPUTER-AIDED DIAGNOSIS

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Background/Objectives: Vascular structures of skin, are significantly involved in pathogenesis, diagnosis, and treatment outcome of skin abnormalities. Presence, morphology and architecture of vessels are suggestive clues for specific abnormalities. However, there has been no systematic technique for comprehensive analysis of skin vasculature. In this study, we propose a three-level framework to systematically detect, quantify and analyze the characteristics of cutaneous blood vessels. Methods: First, we investigate the vessels at pixel-level. We propose novel techniques for detection (absence/presence) and segmentation of vascular structures in pigmented and nonpigmented lesions and evaluate their performance quantitatively. We propose a fully automatic vessel segmentation framework based on decomposing the skin into its constructing chromophores and accounting for shape. Next, we analyze the vessels at lesion-level. We propose a novel set of architectural, geometrical, and graph-based features to differentiate vascular morphologies. The proposed feature set can effectively differentiate four major classes of vascular patterns. Finally, we investigate the vessels at disease-level, where we analyze the relationship between vascular characteristics and diagnosis of the disease. We propose novel features to evaluate total blood area and topological vascular characteristics of the lesion and deploy them to differentiate cancerous from benign tumors. **Results**: Compared to previous studies, we achieved the highest detection and segmentation performance of cutaneous vasculature and state-ofthe-art BCC detection, while preserving clinical feature interpretability. Our proposed approach can be used as a non-invasive and systematic tool for vasculature quantification and can be applied in a broad range of dermatology applications.

Category: Applied/functional Experiments

## AN EMERGING RURAL DERMATOLOGY SERVICE FOR NORTHERN BRITISH COLUMBIA

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The well-established ConsultDerm provides store and forward service to British Columbia. Based on experience, we believe there is a demand for dermatology services using secure mobile technology, complementary to the store-and-forward service. We have partnered with the Northern Interior and Pacific North-West Divisions of Family Practice, as well as Lake Babine First Nation and Carrier Sekani Family Services, to use Blackberry Messenger as part of a "blended model" of dermatology telemedicine and traditional clinic visits. In collaboration with The Centre for Epidemiology and Evaluation we plan to test this model for clinical effectiveness as determined by wait times and clinical tools such as the Dermatology Life Quality Index and Physician Global Assessments among others. In addition, we will assess costs relative to benefits, both in terms of direct health system costs as well as out of pocket costs borne by the patients. A Privacy Impact Assessment of our mobile phone technology is being created with guidance from the Office of the Information and Privacy Commissioner, who has advised us to obtain a "strategic threat risk assessment", which we have requested from UBC IT. This model will eventually include access to educational resources so as to transfer new skills and knowledge into the rural and remote communities. We present here information about the security of this technology, our plan for evaluation, and the model of workflow.

Category: Pilot/exploratory experiments

### IN VIVO ASSESSMENT OF SKIN THICKNESS AND MELANIN RESPONSE TO UV PHOTOADAPTATION

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Background and Hypothesis: Photoadaptation describes the skin's ability to withstand increasing doses of ultraviolet radiation (UVR) with repeated exposure without a phototoxic reaction. Although poorly understood, it involves at least two processes: increased melanin synthesis and epidermal thickening. Currently, there is lack of in vivo human research revealing how melanin and epidermal thickness respond during photoadaptation. We hypothesize that a significant increase in epidermal thickness and melanin will be observed with photoadaptation. **Objective:** To quantify changes in melanin and skin thickness under repeated UVR exposure. Methods: Twenty healthy volunteers with normal skin will be recruited. Characteristic information such as gender, age and skin type will be collected. Two sites on the arm and back will be measured. Before the exposure, minimum erythema dose (MED) will be determined by phototesting. UVR will be given at each site three times weekly, with an initial dose corresponding to 70% of the MED, and a 20% increment at each successive exposure. Up to 20 exposures will be delivered. Each site will be measured by multimodality microscopy, including confocal reflectance, two-photon fluorescence, and second harmonic generation, before exposure and after the last exposure every week. The photoadaptation factor over time will be defined as the delivered UVR dose divided by the baseline MED. Cox proportional hazards regression and linear regression will be used to analyze skin thickness and melanin change when photoadaptation occurs.

Category: Pilot/exploratory experiments

### CHARACTERIZATION OF SKIN CONDITIONS IN FAMILY PHYSICIAN VISITS

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**Background**: It has been discovered that skin conditions rank amongst the most common type of diagnosis presenting to general practice physicians. There is limited published data for the composition of the skin conditions that present in these medical office visits. In this study, our objective is to characterize the most frequent skin conditions presenting to general practitioners. Focus was made primarily on the most common infectious and inflammatory skin conditions presenting at general practice physician visits. **Methods**: We analyzed the British Columbia Medical Services Plan 2013 data that captured universal data on type of patient visits seen by general practitioners. The population in British Columbia was over 4.5 million in 2013, and there were 1,781,726 skin-related patient visits. Skin conditions were those primarily with cutaneous manifestations. All skin-related visits were classified into 20 distinct categories according to their ICD-9 codes. Results: Cellulitis and abscess accounted for 30% of all skin infections, and was the largest category of all cutaneous infections. Contact dermatitis was the largest category amongst all inflammatory conditions, accounting for 42% of all inflammatory conditions. Eczema and Other Dermatitis accounted for the highest number of skin visits overall, right above bacterial infections of the skin. Together, these 2 categories comprised over 20% of all skin-related visits. **Conclusion**: Infectious and inflammatory skin conditions account for a significant portion of skin-related visits to family physician offices. These findings can help inform family physicians on the types of skin conditions that they can expect to find in their office, helping to emphasize the importance of family physician training in dermatology.

**Category:** Exploratory Experiments

### MICRO-RAMAN SPECTROSCOPY GUIDED BY REFLECTANCE CONFOCAL MICROSCOPY FOR *IN VIVO* SKIN MEASUREMENT

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**Background:** Raman spectroscopy is an optical technology to provide a spectral fingerprint of molecules by which the molecules can be identified. It has been used for noninvasive skin cancer diagnosis. To increase the spatial resolution of Raman spectroscopy for interested point measurement, Confocal Raman spectroscopy (CRS) has been developed by using an optical fiber as a pinhole to block out-of-focus signals. To guide confocal Raman spectra acquisition, most systems have integrated a white light imaging channel for selecting the interested point. However, for thick biological tissue samples, white light imaging does not have the section ability deep inside the tissue thus loses its guidance function. **Objective**: Here we are aiming to develop a confocal Raman spectroscopy system for selected point measurement with the guidance of reflectance confocal microscopy (RCM) imaging which has potential to be used for skin measurement in both ex vivo and in vivo applications. Methods: The system used polarized beam splitters to efficiently separate the Raman signal and the confocal signal. The RCM imaging was used to identify interesting microstructures in the skin in vivo for spectral analysis. The system was then able to conduct Raman spectral measurements from the interested target. The system performance was measured and tested on collagen samples and in vivo human skin. Conclusion: With RCM guidance we realized selected target CRS measurement inside human skin tissue in vivo with a lateral and vertical resolution of 2.7 µm and 4.4 µm.

Category: Early experiments with well-defined objectives/hypotheses

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## COSTS AND WORK-RELATED FACTORS OF CUTANEOUS INFECTIONS IN BRITISH COLUMBIA (1990 - 2014)

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**Objectives**: To describe trends in work-related factors and economic impact of occupational-related cutaneous infections reported in British Columbia, Canada over a 25-year period. **Methods:** Retrospective analysis of accepted claims for occupational cutaneous infections and infestations from British Columbia from 1 January 1990 – 31 December 2014. The Workers' Compensation Board of British Columbia database was searched by ICD-9 codes for a common cutaneous infections and infestations. For each accepted claim, age at diagnosis, sex, occupation, days missed from work due to short term disability was collected. Monetary amount of claim awarded was subcategorized into short-term disability, long-term disability, vocational rehabilitation, healthcare costs, and total cost. **Results:** There were a total of 692 cases of occupational cutaneous infectious and infestations identified during the study period, divided into scabies (368) cases), paronychia (125), cellulitis (112), impetigo (270, dermatophytosis (21), candiasis (3). 444 claimants (64%) were female and the mean age was 40 years. Total cost of the claims over period of investigation was \$1,366,024, with average total cost per claim of cutaneous infection \$1974. Mean days away from work due to short term disability was 14.3 days. Common occupations of claimants include nurses, teachers, and child care workers. Conclusion: Cutaneous infections account for considerable cost and days away from work. Claims accepted for occupationally-acquired cellulitis were overrepresented in terms of their proportion of their total cost of claims and proportion of total days away from work due to disability.

Category: Early experiments with well-defined objectives / hypotheses

## HARNESSING THE SKIN IMMUNE SYSTEM TO BUILD A NON-INVASIVE MODEL FOR MONITORING DIABETOGENIC INFLAMMATION

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A limitation in the development of effective therapies for type 1 diabetes is lack of access to tissue that reflects the inflammatory process resulting in beta cell death. Delayed type hypersensitivity is a T-cell mediated skin reaction that allows the monitoring of cellular immune responses to a defined antigen. By subcutaneously administering islet antigens to non-obese diabetic (NOD) mice, we explored the skin's feasibility for non-invasive and invasive tracking of beta cell autoimmunity. We hypothesized that circulating diabetogenic T cells will accumulate both in the pancreas and skin-transplanted islets. The ultimate goal is to develop a skin test to mirror and follow the diabetogenic immune response within the pancreas. Methods: Syngeneic islet equivalents in matrigel were injected subcutaneously into NOD mice. 48, 72 hours and 7 days post injection, the autoimmune destruction of the pancreas and skin-transplanted tissue was visualized by immunohistochemistry, and immune responses in the axillary lymph nodes (ALN) were evaluated through flow cytometry. **Results:** The dermal islets were tracked through immunofluorescent insulin staining. H&E staining of the skin showed progressive immune infiltration of the matrigel. Islet-injected NOD mice did not exhibit increased insulitis score compared to control mice. ALN flow cytometric analysis revealed an increase in absolute number of activated T and B cells. Conclusion and next steps: Our preliminary results suggest that transplanted islets are the subject of a locally defined immune response. To determine if the immune infiltration is specific for autoimmune destruction of the islet cells, hepatocytes will be transplanted with the same protocol.

Category: Pilot/exploratory experiments (for study design, hypotheses creation, etc)

### SYSTEMATIC REVIEW OF THE EFFICACY OF LASER AND LIGHT THERAPY FOR THE TREATMENT OF LENTIGINES AND EPHELIDES

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**Background:** Disorders of cutaneous hyperpigmentation are common and, because of their visibility, can cause significant psychosocial distress for affected patients, leading to low self-esteem and decreased productivity. As such, effective treatments are needed. **Objective:** The aim of our study was to conduct a systematic review of the literature on the efficacy of laser and light therapies for lentigines and ephelides. Methods: Original publications of randomized controlled clinical trials (RCTs) and controlled clinical trials were identified through searches in MEDLINE (Ovid) and the Cochrane Central Register of Controlled Trials (CENTRAL). Results: We identified 13 relevant RCTs for lentigines, involving a total of 414 patients, and 3 relevant RCTs for ephelides, involving a total of 42 patients, which met our inclusion criteria. In these studies, several laser and light therapies including Nd:YAG laser, Er:YAG laser, QS alexandrite laser, QS ruby laser, krypton laser, diode laser, pulsed-dye laser, CO2 laser and intense pulsed light (IPL) were compared against each other and against topical options for the treatment of lentigines and ephelides. Conclusions: The use of the QS Nd:YAG laser or IPL for treatment of lentigines and the use of the alexandrite laser or short-pulsed 532 nm laser for treatment of ephelides was found to have superior efficacy and a good side effect profile in comparison to other laser modalities and topical options.

Category: Early experiments with well defined objectives/hypotheses

## ASSESSING THE VICTORIA AND GREATER AREA EMERGENT AND URGENT DERMATOLOGY REFERRAL PROGRAM

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**Introduction**: Victoria is home to approximately 367,000 people. Every year there are 60,000 emergency visits. Approximately 5-8% of emergency visits are due to dermatologic conditions. An Emergent and Urgent Dermatology Referral program was created to provide timely diagnosis and management for patients seeking emergency care in the Victoria area. This pilot study attempts to assess usefulness of the program. **Methods:** Referral forms were created and distributed to hospitals in Victoria. Patients are seen by one of four consulting dermatologists and a consult is created. Focus group, individual interview and questionnaire were methods used to assess the usefulness of the program. Forms were collected to determine themes in demographics, diagnosis and management strategies. Results: Four referrals have been collected for the purpose of both diagnosis and management. Consults have been conducted within 48 hours for all patients. All referrals have been for "rash", the final diagnosis being drug reaction or viral exanthem. Stakeholders have expressed usefulness and ease of accessibility of the program. No conclusion on demographics have thus far been made due to small sample size. **Conclusion:** This is a novel program for Victoria. The program has led to earlier diagnosis and management of dermatologic conditions in the emergency setting. This early pilot study has determined usefulness and accessibility of the program. Further conclusions will be presented as the program develops robustness.

Pilot/exploratory experiments (for study design, hypothesis creation etc)

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